#19
10

A PRACTICAL MANUAL

OF

PHOTOGRAPHY;

CONTAINING

A CONCISE HISTORY OF THE SCIENCE AND ITS CONNECTION WITH OPTICS, TOGETHER WITH SIMPLE AND PRACTICAL DETAILS FOR

THE PRODUCTION OF PICTURES

BY THE

ACTION OF LIGHT

UPON PREPARED SURFACES OF

PAPER, GLASS, AND SILVERED PLATES,

BY THE PROCESSES KNOWN AS THE

DAGUERREOTYPE, CALOTYPE, COLLODION, ALBUMEN, &c., &c.

BY A PRACTICAL PHOTOGRAPHER.

THIRD EDITION,
ILLUSTRATED WITH WOODCUTS.

LONDON:
PUBLISHED BY W. M. CLARK, 17, WARWICK LANE,
PATERNOSTER ROW,
AND SOLD BY ALL BOOKSELLERS.

1852.

INDEX.

MANUAL

OF

PHOTOGRAPHY.

"Mark how complete the image—ev'ry line
And feature pictured with unerring truth.
No blending colours, no prismatic hues,
To foil the sense, and lead the judgment wrong:
All is correct e'en to the slightest shade.
No artist could to such perfection reach,
Though gifted with a Raphael's matchless skill.
How small the cause! how mighty the effect!
And yet with what facility produced!
The ductile light, through the transparent glass
Passing without restriction, finds, behind,
The polish'd surface of the mingled ore
Opaque and smooth, impervious to its force;
Repulsed its back recoils, but underanged,
And the reflected image stands reveal'd."

By the aid of photography any one may now become an artist; and when it is remembered that we are enabled to copy in a few seconds the most extensive architectural pile, with all the details of elaborate tracery and highly ornamental columns; to preserve faithful pictures of those "English shrines" made holy ground to us by the sacred memories which cling to their crumbling walls; to possess ourselves of most truth-telling representations of those mediæval relics fast mouldering under the imperative touch of slow-wasting time—which stand in their desolation like the embodied past eager to instruct the present, and guide to an enlightened future; and when in addition to all this, photography is found to furnish the best studies of perspective, and to preserve gradations of light and shade in the *natural* beauty and consistency, it will require no argument to convince our readers of the real value of this beautiful art.

When Baptista Porta saw for the first time on the wall of his dark chamber the images of external nature, and traced them to the lenticular character of the small hole through which a beam of light found its way, he little thought of the interesting uses to which the instrument he was led to invent would be applied. Still the camera obscura of the Italian philosopher, although highly appreciated, on account of the magical character of the pictures it produces, remained little other than an amusing toy until the discovery of photography. On the other hand, it is curious to observe how rapidly sometimes new discoveries are followed by others more important than those which led to them, forming the links of a mysterious and infinite chain reaching to an explanation of the wondrous workings of the great Creator of all things.

In the year 1811 Courtois discovered the chemical substance called iodine;

and, as late as 1826, Balard discovered bromine: these two elements are the only substances which in photography form, with silver, a compound sufficiently sensitive to the rays of light, and without such substances this beautiful process could not have existed.

The history of the gradual development of photography is not only curious but instructive, and we, therefore, think our readers will be delighted as we have been in tracing the origin and progress of this discovery.

In 1556 it was noticed that horn silver was blackened by the sun's rays; from this, and other effects, alchymists were led to regard light as one of the most important agents in giving Nature her infinite variety of form; and Homberg says, "That the light of the sun, impinging against terrestrial bodies, modifies them according to their several textures; the luminous matter insinuates itself into the substance of bodies to produce their sulphur, changes the arrangements of their parts, increases them, and, consequently, alters the substances of the body itself, after as many different manners as in different quantities it can be differently placed."

Notwithstanding that many experimentalists pursued the same line of argument and observation, nothing of any value appears to have been arrived at until Petit, in 1722, showed that solutions of saltpetre and sal ammoniac crystallised more readily in the light than they did in darkness.

Charles William Scheele, of Stralsund, in Swedish Pomerania, one of the most remarkable geniuses of his age, first analysed the action and studied the peculiar changes produced by the differently coloured rays of light. He it was who discovered that the chloride of silver spread upon paper was speedily darkened in the blue rays, whilst the red rays produced little or no change.

Dr. Priestly was the first to call attention to the fact that under the influence of light plants emitted considerable quantities of oxygen gas and absorbed carbonic acid gas; thus pointing out a most remarkable instance of the beautiful order observed by Nature in all her works.

It soon after became a question whether the observed chemical changes were produced by the light of the solar rays or by the heat which accompanied them: this induced the celebrated Count Rumford to pursue the subject; and in 1788 this distinguished philosopher communicated to the Royal Society a paper, entitled "An Inquiry concerning the Chemical Properties that have been attributed to Light." The experimental investigations are particularly important and interesting, as marking the progress of the inquiry.

In Count Rumford's experiments, he proceeded to wet pieces of riband and parcels of magnesia with a solution of gold: upon exposing these to the strong light of the sun, they gradually changed colour, and in a few hours acquired a fine purple hue, whilst those kept in the dark remained unchanged. He also found that the decomposition was more readily brought about if exposed in a damp state. He found that etherial solutions of gold were not only acted upon and decomposed by the solar rays, but also by prolonged exposure to diffused light. He argued, from the results of these experiments, that heat is generated by the absorption of light or the sun's rays: at the moment of its generation it exists in infinitely small spaces; and, consequently, it is only in bodies that are inconceivably small that it can produce durable effects in any degree indicative of its extreme intensity.

In 1801, Ritter, of Jena, repeated the experiments of Scheele, and demonstrated the existence of solar rays possessing very powerful properties in producing chemical change, which do not act sensibly upon the organs of vision. In the same year Labillardière brought forward some experiments to prove that light was necessary for the development of pores in plants. He states that blanched plants have no pores; that cresses which were grown in powerful artificial light had not more than half the number found in those plants which had grown under the influence of daylight; and that the coats of

bulbous roots have no pores on the parts which are below the ground, whilst they are found abundant on the parts exposed to the sun.

Michellotti, of Turin, published a paper on the vitality of germs, in which he showed that light was injurious to young plants, and also to young animals.

In 1806, Voyel exposed fat, carefully protected from the influence of the air, to light, and it became in a short time of a yellow colour, and had a very rancid, penetrating taste and smell, producing a bitter, burning sensation in the throat; whereas that which was open to the air, during the exposure of light, always became acid. The same observer found that ammonia and phosphorus exposed to the sun's rays were rapidly converted into phosphuretted hydrogen and a black powder—phosphuret of ammonia; also several metallic compounds were rapidly decomposed by the same agency, light.

In 1800, Dr. Herschel communicated to the Royal Society of London a memoir on the Heating Power of the Solar Spectrum. Previous to this time, it was supposed that each ray contributed its proportional share to the intensity of the heat, which is produced by the concentration of the sun's rays in the focus of a burning-glass. Dr. Herschel, however, suspected that this was not the fact, from the following circumstance:—"In a variety of experiments," says this illustrious philosopher, "which I have occasionally made, relating to the method of viewing the sun with large telescopes to the best advantage, I used various combinations of differently coloured darkened glasses. What appeared remarkable to me was, that, when I used some of them, I felt a sensation of heat, though I had but little light; whilst others gave me much light, with scarcely any sensation of heat. Now, in these combinations the sun's image was also differently coloured, and it occurred to me that the prismatic rays might have the power of heating bodies very unequally distributed among them; and, as I judged it right in this respect to entertain a doubt, it appeared equally proper to admit the same with regard to light. If certain colours should be more apt to occasion heat, others might, on the contrary, be more fit for vision by possessing a superior illuminating power."

The experiments to determine the heating powers of the rays consisted in passing each ray through an opening in a piece of pasteboard, and placing delicate thermometers with blackened balls so that they could be irradiated with each particular colour. The result of these investigations proved that the red rays possessed a greater amount of heating power than any other of the prismatic coloured rays; and also led to the discovery of "rays coming from the sun, which are less refrangible than any of those that affect the sight," and which have the maximum of the heating power.

Dr. Herschel, in describing his experiments to determine the illuminating powers of the different rays, says, "that the yellow and green rays afford the greatest quantity of light, and that the violet ray had the least." He then proceeds to ask, "May not the chemical properties of the prismatic colours be as different as those which relate to heat and light?"

Sir Henry Englefield, at the suggestion of Sir Humphrey Davy, tried several experiments with respect to the power of the several coloured rays in rendering Canton's phosphorus luminous. It was found that the blue rays possessed that power in the greatest degree, and this power, there was every reason to suspect, extended beyond the visible violet ray. In extending our remarks to the very wonderful phenomena connected with the changes produced by light, it will be seen hereafter that our results very materially depend upon this remarkable agent; hence the very interesting discoveries of Herschel will be found to be not only useful and important, but perfectly in place.

M. Seebeck repeated the experiments of Ritter, and he found that a coloured impression of the solar spectrum was made upon paper coated with the chloride of silver. In and beyond the violet rays it became a reddish brown;

in the blue, it was blue or blueish grey; in the yellow, it was white or faintly tinged; and in and beyond the red, it was constantly red.

Dr. Wollaston, without knowing what had been done by Ritter, obtained the same results; and he also discovered some new effects produced by light upon gum guaiacum. Having made a tincture by dissolving this gum in spirits of wine, he spread some of it upon card paper, slips of which were exposed to the differently coloured rays concentrated by a powerful lens. In the violet and blue rays the gum guaiacum acquired a green colour; in the yellow, no effect was produced; in the red rays, the gum already made *green* was restored to its original colour. The guaiacum card when placed in carbonic acid gas could not be rendered green by any of the rays, but was speedily restored from *green* to yellow by the red rays; which change could be as readily produced by passing a heated silver spoon over it.

In June, 1802, Mr. Wedgwood, the celebrated porcelain manufacturer, published, in the journals of the Royal Institution, "An Account of a Method of copying Paintings upon Glass, and of making *Profiles* by the Agency of Light upon Nitrate of Silver; with Observations by Humphrey Davy" This was most certainly the first published account of any attempt to produce images by the decomposing powers of light. Mr. Wedgwood employed white paper, or white leather, moistened with a solution of nitrate of silver. Notwithstanding the imperfect character of his process, it is so very interesting, as the first attempt to produce pictures by light, that we shall copy the author's description of it, and a few of his remarks, from the memoir :—

"White paper, or white leather, moistened with a solution of nitrate of silver, undergoes no change when kept in a dark place; but, on being exposed to the daylight, it speedily changes colour, and, after passing through different shades of grey and brown, becomes at length nearly black. The alterations of colour take place more speedily in proportion as the light is more intense. In the direct beams of the sun, two or three minutes are sufficient to produce the full effect; in the shade, several hours are required; and light transmitted through different coloured glasses acts upon it with different degrees of intensity. Thus it is found, that red rays, or the sunbeams passed through red glass, have very little action upon it; yellow and green are more efficacious, but blue and violet light produce the most decided and powerful effects.

"When the shadow of any figure is thrown upon the prepared paper, the part concealed by it remains white, and the other parts speedily become dark. For copying paintings on glass, the solution should be applied on leather: and in this case it is more readily acted on than when paper is used. After the colour has been once fixed on the leather or paper, it cannot be removed by the application of water, or water and soap, and it is in a high degree permanent. The copy of a painting or the profile, immediately after being taken, must be kept in a darkened place; it may, indeed, be examined in the shade, but in this case the exposure should be only for a few minutes; by the light of candles or lamps it is not sensibly affected. No attempts that have been made, to prevent the uncoloured parts of the copy or profile from being acted upon by light, have as yet been successful. They have been covered with a thin coating of fine varnish; but this has not destroyed their susceptibility of becoming coloured: and, even after repeated washings, sufficient of the active particles of the saline matter will still adhere to the white parts of the paper or leather, to cause them to become dark when exposed to the rays of the sun. Besides the applications of this method of copying that have been mentioned, there are many others; and it will be useful for making delineations of all such objects as are possessed of a texture partly opaque and partly transparent—the woody fibres of leaves, and the wings of insects: in this case it is only necessary to cause the direct solar light to pass through them, and to receive the shadows upon the prepared leather."

Sir H. Davy says, "that the images formed by means of the camera obscura have been found to be too faint to produce, in any moderate time, an effect upon the nitrate of silver. To copy these images was the great object of Mr Wedgwood, in his researches on the subject: and for this purpose he first used the nitrate of silver; but all his numerous experiments proved unsuccessful. In following these processes, I have found that the images of small objects, produced by means of the solar microscope, may be copied without difficulty on prepared paper. This will probably be a useful application of the method; that it may be employed successfully, however, it is necessary that the paper be placed at only a short distance from the lens. It is also more readily acted upon when moist than when dry—a fact long ago known. Nothing but a method of preventing the unshaded parts of delineation from being coloured by exposure to the day, is wanting to render this process as useful as it is elegant."

The failure of two men so eminent as Sir Humphrey Davy and Wedgwood, in their attempts to produce light drawn pictures, appears to have discouraged any further experiments of this kind at that time in England.

In 1814, M. Niepcé, of Châlons, on the Saône, a gentleman of some property, pursuing chemistry as his chief recreation, turned his attention to the chemical agency of light—his object being to fix the images of the camera obscura; and he appears to have discovered the peculiar property of light in altering the solubility of many resinous substances.

In 1824, M. Daguerré began a series of experiments with the same object in view, being a friend of M. Niepcé and aware of his processes. The first substances he tried were papers impregnated with a solution of the nitrate or chloride of silver; but his ill success induced him to abandon them. M. Niepcé being in London in the December of 1827, he communicated to the Royal Society an account of his experiments, together with several pictures on metal plates, in the state of advanced etchings—the etching being effected by acid, subsequent to that part of the process in which light assisted in laying bare portions of the resin-covered plate. These prove that M. Niepcé was acquainted with the method of making the shadows and lights of his pictures correspond with those of nature, and of rendering his copies impervious to the erasing effects of the solar rays.

In a paper, dated the 5th December, 1829, M. Niepcé communicated to his friend Daguerre the particulars of the process employed by him; and they entered into an agreement to pursue, for their mutual benefit, the researches which they had respectively begun.

As many parts of this process are very curious and interesting, it will be as well to devote a brief space to a few extracts from M. Niepcé's own paper, which he commences by saying, he "shall call the discovery by the name of Heliography," which consists in producing spontaneously, by the action of light, with gradations of tints from black to white, the images received by the camera obscura. "Light, in its state of composition and decomposition, acts chemically upon bodies. It is absorbed, it combines with them, and communicates to them new properties. Thus it augments the natural consistency of some of those bodies; it even solidifies them, and renders them more or less insoluble, according to the duration or intensity of its action."

"The substance which has succeeded best with me, and which concurs most immediately to produce the effect, is asphaltum or bitumen of Judæa, prepared in the following manner:—I about half fill a wine-glass with this pulverised bitumen. I pour upon it, drop by drop, the essential oil of lavender, till the bitumen can absorb no more. I afterwards add as much more of the essential oil as will cause the whole to stand about three lines above the mixture, which is then covered and submitted to a gentle heat, until the essential oil is fully impregnated with the colouring matter of the bitumen. If this varnish

is not of the required consistency, it is allowed to evaporate slowly, without heat, in a shallow dish, care being taken to protect it from moisture, by which it is injured, and at last decomposed. A tablet of plated silver is to be highly polished, on which a thin coating of the varnish is to be applied cold, with a light roll of very soft skin; this will impart to the tablet a fine vermillion colour, and cover it with a very thin and equal coating. The plate is then placed upon iron heated, which is to be wrapped round with several folds of paper to expel all moisture. When the varnish has ceased to simmer, the plate is withdrawn from the heat, and left to cool and dry in a gentle temperature, carefully protected from a damp atmosphere. The plate, thus prepared, may be immediately submitted to the action of light in the camera obscura from six to eight hours. After having been thus exposed sufficiently long for receiving the impression of external objects, nothing is apparent to show that the impression exists. The next operation, then, is to render the picture visible, which is to be accomplished by the aid of a solvent. This solvent consists of one part of the essential oil of lavender, and ten of oil of white petroleum. Into a vessel of sufficient size pour enough of this solvent to cover the plate, into this the tablet is plunged, and the operator, observing it by reflected light, begins to perceive the images of the objects to which it had been exposed gradually unfold their forms. The plate is then lifted out, and held in a vertical position till as much as possible of the solvent has been allowed to drop away. The picture is now to be carefully washed, by being placed upon an inclined plane, over which a stream of distilled water is slowly poured. It should be observed that the light solidifies the varnish, and renders it less soluble than the parts upon which the shadows have fallen."

In the same communication, M. Niepcé says, "It were, however, to be desired that, by blackening the plate, we could obtain all the gradations of tones from black to white. I have, therefore, turned my attention to this subject, and employed at first liquid sulphuret of potash; but, when concentrated, it attacks the varnish, and if reduced by water, it only reddens the metal. This twofold defect obliged me to give it up. The substance which I now employ is *iodine, which possesses the property of evaporating at the ordinary temperatures.*"

M. Daguerre, in experimentalising on these substances, seems to have been dissatisfied, for he says:—"This heliographic process is exceedingly tedious and uncertain. An exposure of two or three hours is necessary to produce an impression from an engraving, even under the influence of a bright sun; and in the camera the plate must be left under the influence of strong light for six or eight hours, or longer, before a tolerable picture can be produced." He therefore set about improving this process; and the resin of the essential oil of lavender, dissolved in alcohol, was found by him to be more susceptible of change than the bitumen; instead of washing the plate with the solvent recommended by M. Niepcé, which often removed all the varnish from it, he exposed the tablet to the vapour of petroleum, and a more certain effect was the result.

In 1831, M. Niepcé regrets that he had lost so much time in his experiments with iodine, and says:—"I do not see that I can hope to derive any advantage from this more than the use of other metallic oxides." He also tried a decoction of *Capsella bursa-pastoris*, or shepherd's purse, the fumes of phosphorus and of sulphur, as substances acting upon silver in the same way as iodine. The philosopher of Chalons' experiments were thus progressing, when he suddenly died in July, 1833.

In 1834, Mr. Henry Fox Talbot, well known as a natural philosopher, began some experiments, with a view of rendering the images of the camera obscura permanent. On the 31st of January, 1839, six months prior to M. Daguerre's process being announced, he published a paper, entitled, "Some

Account of the Art of Photogenic Drawing; or, the Process by which Natural Objects may be made to delineate themselves without the aid of the Artist's Pencil." This was read before the Royal Society; and on the 21st of February he communicated to the same society the method of preparing the paper, and the whole process by which the design was to be fixed.

In June, 1839, the discovery of M. Daguerre was reported, and specimens shown to the scientific world of Paris, which the French Government submitted to the Academy, to be reported on previously to the purchase of the secret method of conducting the process. In July, a bill was passed securing to Daguerre a pension for life of 6000 francs, with a reversion of half to his wife; also 4000 francs to the son of M. Niepcé, with the like reversion to his wife. France then declared that she purchased the secret of the process for "the glory of endowing the world of science and of art with one of the most surprising discoveries which conferred honour on her native land." M. Duchâtel, the then Minister of State, gave as the principal reason for voting this handsome pension to Daguerre, "that the invention did not admit of being secured by patent, for, as soon as published, all might avail themselves of its advantages." M. Arago says:—"This discovery France has adopted, and, from the first moment, she has cherished a pride in freely giving it to the whole world."

In the face of all these representations to obtain a pension, M. Daguerre, as soon as it was secured, in a most unworthy and illiberal spirit, instructed a person in this country to obtain a patent, and in that way exclude England alone from the advantages of the discovery, unless good, easy John Bull chose to bleed handsomely, to be put upon equal terms with his neighbour. This "patent," indeed, will not admit of any justification; it is, to say the least, but an "ill return" for the liberal reward so freely and so readily bestowed by the French Chamber of Deputies upon MM. Daguerre and Niepcé —a reward which, in all probability, would never have been extended to them and their families, had it been foreseen that it would have enabled *them* to exercise a future power over an invention thus *purchased;* and with the following words of the very able Edinburgh Reviewer we most cordially agree:—

"That a *monopoly* does exist, and that it exists in a manner both unjust and injurious, is equally apparent. It is upheld by means of a patent which, in its origin, was bad; and in its continuance is, we affirm, disgraceful, as must be admitted by any unprejudiced person at all versed in the subject of the patent and common law of the country; and the public should be rendered thoroughly aware, that something like a deception must have been practised upon her Majesty's Attorney-General, when he allowed this patent right to be *legalized.* It was clear that Daguerre had no property in the invention when this obnoxious patent was granted, as he had previously and entirely sold it to the French Government, and had engaged, in addition to what he then knew, to render public all his future improvements and discoveries in the art. We deny in the first place, that he had the power to sell his original discovery in this or any other country; it only admits of a doubt whether he might fairly withhold the use of the after-improvements *from us* until we had paid for them. Daguerre knows that France thoroughly purchased his secret, and that while she liberally rewarded him, she offered it freely as a gift to the *whole world*—a boon to universal science, a donation to the arts—and that she nobly sought to open out a source of amusement and instruction to every class of society. All the nations of Europe, save one, and the whole hemisphere of the New World, have welcomed the generous gift. They have received the free use of it for all their subjects; they have improved its processes; they have applied it to the arts; they have sent forth travellers to distant climes to employ it in delineating their beauties and their wonders. In England alone, the land of

free trade—the enemy of monopoly—has the gift of her neighbour been received with contumely and dishonour. It has been treated as contraband, not at the Custom House, but the Patent Office; and, much as we admire the principle of our patent laws, as the only reward of mechanical genius under Governments without feeling and without wisdom, we would rather see them utterly abrogated than made, as they have been in this case, an instrument of injustice. While every nation in the world has a staff of pilgrim philosophers, gathering on foreign shores the fragments of science and practical knowledge for the benefit of their country, England marshals only a coast-guard of patent agents, not to level duties, but to extinguish lights; not to seize smugglers, but to search philosophers; not to transmit their captures to the national treasury, but to retain them as fees and profits to interested individuals.

The announcement of Daguerre's discovery induced Mr Fox Talbot to publish immediately certain results which he had obtained with the chloride of silver: these will be found in the Philosophical Magazine for March, 1839. In this communication Mr. Fox Talbot gives every instruction for the production of negative and positive images; in fact, details all that is necessary for the process of printing from the negative image on paper.

On the 14th of March, 1839, Sir John Herschel made his first communication to the Royal Society on the subject of photography, and then published "The Use of the Liquid Hyposulphites for Fixing the Photographic Impression." On February 20, 1840, the same eminent philosopher made his second communication in which amidst many novel processes he mentions, first, the use of hydriodate of potash for bleaching a dark surface, and thus forming an iodide of silver: he says, "A positive paper of this nature is actually prepared for sale by Mr. Robert Hunt, of Devonport, specimens of which he has been so obliging as to send me, and which certainly give results of great promise in this line," and secondly the use of iodide of silver. "I find," he also says, "that glass so coated with iodide of silver is much more sensitive than if similarly coated with the chloride."

At the meeting of the British Association at Plymouth in 1841, Mr. Robert Hunt communicated a very sensitive Photographic process in which the ferrocyanate of potash was employed on iodized paper. As this is important, we copy a portion of Mr. Hunt's communication from the Report of the British Association for that year, which clearly gives to every one the right of preparing iodized paper after his method. "Highly glazed letter-paper is washed over with a solution of one drachm of nitrate of silver to an ounce of distilled water; it is quickly dried, and a second time washed with the same solution. It is then, when dry, placed for a minute in a solution of two drachms of the hydriodate of potash in six ounces of water, placed on a smooth board, gently washed by allowing some water to flow over it, and dried in the dark at common temperatures." In what essentiality Mr. Fox Talbot's iodized paper, patented in 1842, differs from this, we cannot discover. We leave the question of the propriety of patenting the inventions of other experimentalists to be settled by the patentee.

Again, in Sir John Herschel's paper already quoted, we find the following words: "I was induced to try in the first instance a variety of mixtures of such organic soluble compounds as would not precipitate that salt (nitrate of silver). Failing of any marked success in this line (with the somewhat problematic exception of the gallic acid and its compounds), the next idea," &c.; and again, after speaking of fixing the pictures obtained on iodide

and bromide of silver, Sir John Herschel says they "may be finally fixed with hyposulphite of soda, which must be applied hot."

We will now turn to Mr. Fox Talbot's patent of 1842. The specification of this gives—first, nitrate of silver, secondly, iodide of potassium washed over the best writing-paper, and then with clean water—this he calls "iodized paper, because it has an uniform pale yellow coating of iodide of silver." We know nothing of the patent laws if they allow any individual thus completely to seize upon the invention of another and make it his own. The use of gallic acid combined with nitrate of silver is clearly the result of Mr. Talbot's investigations, and to the very beautiful effects obtained by this—the calotype process—no one is disposed to deny his fair claim; and we are convinced that he would not upon consideration be disposed to push his claims as a patentee further than this. In the second patent "hot hyposulphite of soda" is claimed, but this we have seen belongs to Sir John Herschel. In 1840, writing of a picture on glass, he says, "after drying, it was restored, and assumed much the air of a Daguerreotype when laid on a black ground, and still more so when smoked at the back—the silvered portions reflecting most light, so that its character had in fact changed from negative to positive."

At York, in 1844, Mr. Robert Hunt published the important use of the protosulphate of iron as a developing agent, and at the same time Dr. Woods published his catalissotype process involving the use of the iodide of iron. In Mr. Talbot's last and most sensitive process we find these two salts, the protosulphate of iron and the iodide of iron, combined to produce the sensibility: and this process he has also made the subject of another patent.

In Paris, at this moment, the most exquisite sun pictures of more than eighty square inches' surface may be purchased at every stationer's for about four shillings each, representing all that is wonderful and beautiful in nature and art, and such pictures as command the adoration and admiration of our very best artists; and it is no trifling evidence of the power, influence, and growth of art in this country, that the most talented photographists in Paris are almost wholly employed in manufacturing for this country; and to the eternal disgrace of the influence, whatever it may be, some of our finest discoveries are only publicly worked in a foreign country. The last and most wonderful of modern discoveries, Wheatstone's Stereoscopic Pictures, are now made upon glass by M. Soleil, of Paris; and, when seen by transmitted light, the effect, with one small exception, is all that can be required. The simple addition of a little transparent colour will render these pictures complete miniature reflections of nature. When selfishness and vanity no longer stand between Divine bounty and man, then the poorest of our thousands emigrating to a foreign land may bear with them the reflected image of their relatives and homes grouped into one beautiful picture, to realise daily their hopes and yearnings for a sight of home, however humble, and with it the recollections and associations of all that is pleasurable, and which only lasts on the emigrant's memory.

From this digression we now proceed onward in our course of enquiry into the development of the Daguerrian process. The year 1839 gave birth to this, and also the Electrotype process—two of the most extraordinary discoveries of human ingenuity, which, from the similarity of their results, may be called sister arts, both acting under two of the most mysterious agents of Nature's wonderful works—the one under the influence of light, the other under that of electricity: in the first, light draws; in the latter, electricity models. With the original process it was considered impossible to apply it to production of portraiture; for with iodine alone and the long-focus lenses employed at first, no picture could be taken in less time than from fifteen to thirty minutes. As the correctness of a portrait produced by this art depends upon

perfect immobility during the whole of the sitting, the bare idea of such an application of Photography was thought altogether absurd.

It was, however, soon found, that by constructing object-glasses with a shorter focus, the operation could be reduced nearly in proportion to the reduction of the length of the focus; so that, by making use of an object-glass of three inches focus, instead of twelve, the operation is shortened by four times; and by this we were enabled to take portraits. But still, few persons could remain perfectly quiet for even this length of time, and, if able to do so the painful constraint given to the countenance was most unpleasant to look upon. About this time an ingenious optician of New York, Mr. Woolcott, thought of substituting for the *refracting* glasses a concave mirror of such an aperture that a greater amount of light from the object might be concentrated at its focus, where he placed the sensitive plate. He was thus enabled to reduce the time required to obtain a portrait very materially. This was an interesting step in the improvement of the art; although its defects rendered it inferior in some respects to the refracting apparatus. The mirror, if made of metal, being constantly exposed to the action of the atmosphere, was liable to corrosion or oxidation; if made of glass, then two images of different focus were formed—the one from the silvered surface, the other from the surface of the glass, so that a sharp or well-defined image could not be produced. Another material defect was the necessity of placing the plate between the object and the mirror; a small-sized picture only could be taken, or the plate would have screened the greater part of the aperture, and the advantage of the increased reflecting surface would be lost. The rays, also, producing the best definition and the most correct image are reflected from the centre of the mirror, which must be to a considerable extent lost from the unavoidable position of the plate. Nevertheless, the invention of Mr. Woolcott was a very clever and ingenious arrangement, and at that time a great improvement, and deserves to be recorded in our history of photography; more especially as the same gentleman subsequently made many other improvements; one of which was the very good and sensitive mixture now known as "Woolcott's American Accelerator," but which we shall have occasion to notice more fully in another part of our treatise.

About this time Mr. John Goddard, a very clever chemist, was making various experiments, and discovered that the addition of chlorine to the iodine rendered the plate not only very sensitive, but gave a much better tone to the picture. He succeeded in producing some of the best results that could be wished. Subsequently he discovered the extraordinary property of bromine in rendering the iodised plate so peculiarly sensitive, that from minutes the process has been reduced to only seconds to obtain good pictures; indeed, so astonishingly sensitive is this compound of bromide of iodine upon the silver plate, that in the clear sunshine of our summer days a picture may be produced with the rapidity of a flash of lightning. It but remained to fix this beautifully delicate image upon the surface of the plate: this great improvement was discovered by M. Fizeau, who boiled a solution of hyposulphite of soda with chloride of gold upon the plate, and thus gave it a transparent coating of the most unchanging of metals, rendering the picture more forcible, deepening its tint, and preserving it unchanged.

We must not forget to make honourable mention of M. Claudet*, who has been incessantly engaged in the art for several years past, and who has done much to improve it, by supplying the public with not only the best productions of the art, but studied to infuse an artistic taste into their composition as pictures.

* M. Claudet's specimens of the art are open to the inspection of the public; and will repay a visit to his gallery, 107, Regent Street.

THE

PHOTOGRAPHIC PROCESS.

E now proceed to describe, in due order, the various photographic processes. Above all things, we wish to impress on the mind of the experimenter the necessity which exists for extreme care in every stage of the manipulation; we cannot lay down a *Royal road* to acquire an art which involves the most delicate chemical changes—requiring the most patient perseverance to surmount the difficulties which surround it—and more than ordinary caution in selecting materials for use.

The entire process is comprised in the nine distinct operations, which we shall endeavour to explain as simply as possible, at the same time entering into all necessary detail.

1. Cleaning and polishing the plate.
2. Applying the coating of iodine.
3. Subjecting the plate to the vapours of bromine-water, or other accelerating substances.
4. Exposing the plate in the camera.
5. Subjecting the plate to the action of mercury.
6. Depriving the plate of its sensitive coating in the hyposulphite solution.
7. Washing the plate in pure distilled water.
8. Fixing the image with solution of the chloride of gold.
9. Washing the plate in distilled water, and drying over a spirit-lamp.

Again impressing upon our readers the necessity of proceeding with patience through each different operation, which, after a little practice, will be found very easy, but if not attended to, failure will inevitably be the result.

Cleaning the Plate, &c.—Be careful in selecting good plates to begin with: the French are very inferior; the best are the Soho-manufactured plates; and should have a strong metallic lustre, without specks. A slight line or scratch is no obstacle to obtaining a fine impression, provided always the scratches do not reach the copper; and care must be taken, when operating for a portrait, to place the head upon the part of the plate which is free from imperfections. The articles employed in the cleaning operation are cotton-wool, tripoli, prepared lamp black, olive oil, nitric acid diluted with about sixteen parts of

water and, a cotton velvet buff. As it is a principal object in cleaning the plate to obtain a surface of silver perfectly pure, care must be taken that the articles used for that purpose are free from impurities, and that the plates should not be prepared in any place where there may exist vapours arising from acids, volatile oils, iodine, bromine, &c. It is therefore recommended, as a necessary precaution in the former respect, that the cotton-wool be carefully selected of the finest quality.

The velvet should previously be freed from its gum and grease by steeping it for half an hour in boiling water, draining and drying it without touching it with the fingers more than possible. The tripoli should be reduced to an impalpable powder, and preserved for use in a small muslin bag, which should be placed in a box, so as to preclude the possibility of the slightest admixture of dust with the tripoli powder. The lamp-black should be prepared by rendering it red-hot in a crucible, till all vapours cease to arise from it; the crucible should then be removed from the fire, and closely covered up until it has cooled, when the lamp-black should be reduced to a fine powder in a mortar, and preserved for use in the same manner as the tripoli.

The Soho plates, or Sheffield-manufactured plates, are so highly polished that they require but little doing to them to render them fit for immediate use; but the very best polishing process and one that will never be found to fail, is obtained by using a small lathe. (Fig. 1.) We have a circular block of wood (A), about 7 inches in diameter, well covered with a piece of fine blanket, over which the velvet is stretched very tight, screwed on to the headstock spindle, against which we press the plate, held in a plate-holder (B): this consists of a square plate of polished steel, rather larger than the silver plate, round which is either a fixed or movable flat rim, forming a space the size of the plate, and just sufficiently deep to allow of the silvered surface of the plate remaining above the rim. A brass boss is placed at the back of the holder, having a cup-shaped hole in its centre, into which is a steel spindle C fits loosely. Motion is now given to the buff, and the plate in holder moved slightly backwards and forwards upon the lathe-*rest*, keeping the velvet well dusted with the prepared charcoal, or, what is better, prepared charcoal with a small quantity of the finest rouge mixed with it.

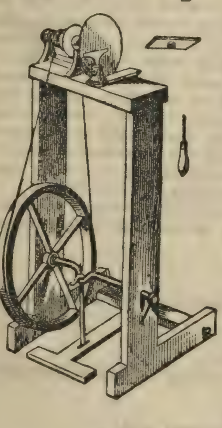


FIG. 1.

After a few revolutions the plate should be examined; if sufficiently polished, it will appear of a brilliant and even *jet*, and should be removed. It may, perhaps, appear difficult to conceive how the plate can be cleaned or polished with a revolving plate-holder, the buff revolving at the same time: but we must recollect that the plate-holder should not be held in the centre of the buff; or, in other words, the centre of the plate-holder and the centre of the lathe must not coincide; but if the two centres are but a very little removed from each other, then the plate and buff revolve in opposite directions, and thus the plate is perfectly and evenly cleaned and polished.

It is generally necessary to make use of the usual shaped straight handbuff (*fig.* 2), to give the plate its final polish.

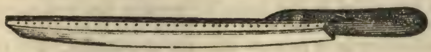


Fig. 2.

This buff consists of a piece of wood covered with clean cotton velvet, and slightly curved, so as to allow for the deviation from the parallel direction which the motion of the hand invariably takes in the operation of buffing. Dust a little of the prepared lamp black on the velvet, and briskly polish. holding the plate, if a small one, on the ends of the fingers of the left hand, and using the buff with the right : if a large plate, place it face downwards on the rubber, moving the plate up and down by means of the fingers, with a slight degree of pressure, taking care that for portraits the movement should not be in the direction of the face, but across it ; and it is also best for this last polish to be given in a dark part of the room, as the clear daylight affects the bright surface of the silver, injuring its sensibility.

It has been also observed that the elevation of temperature produced by the buff causes the plate to become iodised much sooner, and its combination with the surface is thereby rendered more perfect.

If the plate be one that has been previously used, it should be placed, silver side upwards, upon a piece of clean white paper, and shake a small quantity of the tripoli over it; a few drops of olive oil should then be applied, and with a knot of the cotton and a light hand proceed to clean the plate by a series of circular movements, equally over its surface, adding more tripoli if required. The time usually expended for producing a good surface is about five minutes. The plate should be laid face downwards, upon a velvet buff kept on purpose, which may be marked No. 1, (or, what is better, have a circular buff fitted to the lathe for this part of the process), and rubbed backwards and forwards, until an apparently clean and pure surface is obtained. This will not be the case; for the surface is still *chemically greasy.* The plate, therefore, to be freed from this, requires burning. To effect this, hold the plate by one corner, with a small pair of pliers, over a spirit-lamp, until white spots or clouds appear on the surface; the lamp should then be withdrawn, and the plate suffered to cool. This part of the process requires some care, for if the plate be not heated enough, white clouds will form in the after finishing process It will also be almost impossible afterwards to obtain that fine black polish which is so essential to a good daguerréotype, and the shadows will appear full of innumerable minute white spots, giving a grey appearance to the whole picture. Much care is necessary when using French plates, as, from their being so much thinner, they bear but a slight heat, and if heated too much are liable to bend ; it is safer and better to clean these with spirits of wine alone, and not attempt to use oil— they will then do without burning.

When cold, apply, by means of a piece of cotton-wool, a few drops of the dilute nitric acid over the plate, which will immediately indicate if it has been sufficiently heated by its flowing easily over its surface, without running into distinct globules, which it would otherwise do: if the acid wets the surface easily, dust a little tripoli over it, and with a fresh piece of cotton-wool dry the acid off in the same manner as you did the oil, but, if the acid does not adhere to the plate, it will require to be rubbed with the tripoli for a little time longer before drying it off.

After this, the second, or finishing, buff of the lathe is employed, all possible care being taken to keep this free from grease. When a

number of plates are to be done, it is best to oil, buff, and burn them all, before commencing the polishing process on the second buff: plenty of the mixed charcoal and rouge should be used, and the buff well applied to the plate until a fine polish is obtained—the pressure being moderately strong at first and then gradually lessened; the plate should be finished by a quick revolution and a very light pressure with the plate-holder. The plate should be taken away during its revolution: but in inexperienced hands this is rather a difficult thing to do, particularly with large plates, for they are apt to fly out of the holder and be damaged by falling—to avoid this, we prefer using the plate-holder with a moveable rim and adjusting screws;—if this can be accomplished, the plate will present a fine black polish, with *no visible marks of the velvet*, whereas, if the lathe is stopped, and the plate then removed, it will have a circular *grain* on its surface, indicating the last revolution of the buff: the plate should either have no visible grain, or it should have it in one direction only, as pointed out for finishing new plates.

Instead of the dilute nitric acid, some operators prefer a weak solution of caustic potass, or alcohol in which a little caustic potass has been dissolved is said to improve the tone and colour of the future picture; others prefer using two buffs, dispensing with the acid or alcohol: buff No. 1 is first used with plenty of charcoal powder, to polish off the white film formed by heating the plate; whilst with the second, or No. 2 buff well dusted with the charcoal and rouge, the final polish is given. Clean buff or wash-leather may be substituted for the cotton velvet on the buffs; and rottenstone may be used instead of tripoli. It may be prepared sufficiently fine in the following manner: select a piece of rottenstone (not the powdered), having a light buff colour, reduce the stone to powder in a mortar, and then throw it into a basin of clean water, allow it to stand a few minutes, and pour off the supernatant liquid, which will have in suspension all the finer particles of the rottenstone, the sand and coarser particles remaining at the bottom of the vessel. By allowing the liquid to stand a shorter or longer time we may obtain the rottenstone of any degree of fineness. In order to get rid of the water, the liquid should be left undisturbed until it has become quite clear; the water may then be gently poured off, and the rottenstone powder dried on a plate at the fire, or used in the pasty state.

To some it may be very difficult to hold the plate firmly in the fingers, to clean and polish it: should this be the case, several forms of plate-holders have been made for the purpose (*figs.* 3, 4, and 5). *Fig.* 3 is the French pattern, now not so much in use as *fig.* 4—a simple

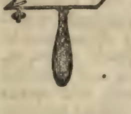


Fig. 3.

Fig. 4.

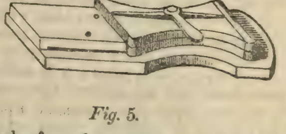


Fig. 5.

and very good one. It consists of a block of wood, somewhat in the form of a dice-box, on one end of which is screwed a piece of wood, a trifle smaller than the plate to be polished; on the upper part of this is fixed, by heating the surface with a hot iron, one or more pieces of Indian-rubber: thus the rubber is rendered permanently adhesive, so that the back of the plate when pressed against it adheres firmly; at the same time there is no difficulty in removing the plate when necessary. *Fig.* 5 is perhaps the best form of plate-holder, contrived and made by the Messrs. Knight of Foster-lane, Cheapside; who keep the best, cheapest, and most extensive assortment of apparatus of every description

for the Photographic and other processes. It is particularly adapted for either thin, small, or large plates, and consists of an iron clamp, screwed down upon the edge of a block a trifle smaller; by a simple contrivance, this block is made to shift to adapt itself to a plate of any size, it can also be reversed so as to buff either way of the plate.

We are more particular in dwelling upon this the first and most important part of the process, as every thing done at this stage should have for its object that of finally leaving the plate *chemically clean,* and with as pure a surface of polished silver for the iodine to combine with as it is possible to obtain · to effect this object, we have been induced to deposit a surface of the *purest silver* upon our beautifully polished silver plate by the electrotype process. For this purpose, one small cell or battery is sufficient; this is placed in connexion with a glass cell containing a saturated solution of the oxide of silver and cyanuret of potassium (*Fig.* 6) to the silver pole or wire of the battery a sheet of thin silver foil is connected and immersed in this solution; to the zinc pole, or other wire a pair of small pliers is firmly secured by a small binding screw, and between these pliers the plate is held, (*Fig.* 6.) and immersed in the cyanuret of silver solution for about two or three minutes; the plate must next be taken out and thrown into water, and then carefully dried off with the spirit-lamp as recommended for finally drying the picture: when dried, it requires re-polishing with the *hand-buff,* well dusted with the prepared charcoal and rouge; this should be done as evenly as possible or the iodine will be liable to attach itself to one part more than another. Care should be taken in the first instance, when cleaning the plate, to clean both sides, the copper as well as the silver, or the pure silver will be deposited unequally, and the result imperfect. By this means we obtain a pure surface, and the picture taken upon such a surface will be far superior to those taken without this additional trouble. After the plate has been thus cleaned, polished, and prepared, it is ready for the second or Iodising Process.

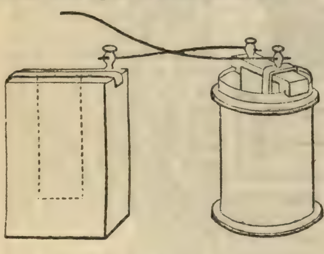
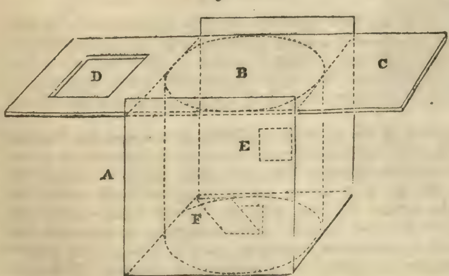


Fig. 6.

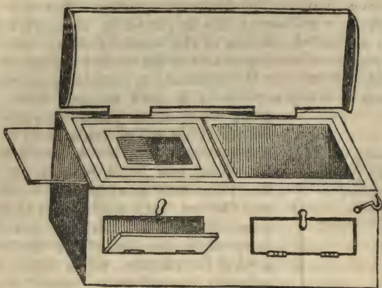
Iodising of the Plate.—To effect this we use a glass pan, enclosed in a square box, with a piece of plate glass double the length of the pan to slide over the top, in the one half side of which an aperture is cut, capable of admitting a small wooden frame, having a narrow groove just to receive the plate, and prevent it from falling through. The accompanying diagram (*fig.* 7) will, however, best

Fig. 7.



explain the construction of the iodising-box. A represents the square box, containing a round glass pan (B), *with ground edges*, upon the top of which slides the plate glass cover C, *with an aperture* (D) to receive the grooved frame upon which the plate to be iodised rests. E *is a small hole of two inches* square, cut in the wooden box, through which the light is admitted and received upon the piece of looking-glass at F, *placed at a convenient angle*, so as to embrace the plate *undergoing the iodising process* and the patch of white light *admitted from the opposite side of the box*. But as two of these boxes are required, one for *applying the vapour of iodine*, the other for the bromine or other accelerating agent; Messrs. Knight have had constructed the double box in a neat and portable form, as represented in *fig* 8. Both pans are here placed in the same box, the frame holding the plate sliding in a groove from the one to the other, each being provided with a distinct glass cover to fit. The frames for the plates should be well varnished, when made of wood, or they will absorb the iodine and bromine vapour, and prevent the edges of the plate from receiving an even coating. A piece of black cloth thrown over the top of this box will exclude the light sufficiently well during the removal of the plate from the iodising pan to the dark box of the camera.

Fig. 8.



The practical utility of this arrangement for the iodising-box or pan will be readily preceived. The white reflected light, and the plate undergoing its changes, being at once presented to the eye by means of the small piece of looking-glass, the same colour can always be obtained upon the plate, and the process stopped at the precise moment of time. The construction of this box also effectually precludes an escape of the fumes of the iodine from the box itself, which, we have before demonstrated, has occasioned a greater number of failures than any other cause of non-success. Indeed the photographic experimentalist cannot be "over careful" in the selection and so forth of the apartment in which his plates are to be prepared, inasmuch as damp or fresh paint, and a variety of other apparently very trivial causes, will affect the surface of the preparing plate.

The most unphilosophical observer of nature must be cognisant of the well-known fact, that, when we expose to a warmer air any cold body, the humidity contained in the former becomes condensed; and to this cause we may attribute the difficulty experienced by the photographist when operating in any atmosphere affected by moisture, frequently the case in that of an ordinary room.

The vapour arising, *even at the slightest variation of temperature*, between the surface of a body and the surrounding air, contains in suspension a non-volatile substance, which subsequently becomes what might be called the atmospheric deposit; for, so soon as an equal temperature is established between the air and the surface of that body, the humid vapour which had condensed upon it then becomes volatile, and, depositing as sediment that which it previously held in suspension, again mixes with the air, and is again saturated with that impure substance for a subsequent deposit. It is quite

evident that this moist coating is *very* injurious. Thus, if you breathe several times on the plate, when first taken out of the camera, the mercurial vapour will not then "bring out" the image. In order, therefore, to paralyse this baneful effect as much as possible, the temperature of the workroom must remain at about 60 deg. Fahrenheit, and the plate may be kept even higher than that of the air which surrounds it during each of the operations.

Directions for Iodising.—Insert the polished plate in the groove, pushing the glass cover sufficiently to place the plate directly over the iodine covering the bottom of the glass pan. Allow the plate to remain until the rose colour is obtained; then draw back the cover, take out the plate, and transfer it quickly to the accelerating pan, in which it should continue from two seconds to twenty, to be determined by the strength of the mixture used (which we shall more fully describe presently). The colour should now be slightly changed, and, the roseate hue deepened, the plate should then be re-transferred to the iodising pan, where the colour can be deliberately observed by comparison with the white reflected light. The plate must be permitted to remain in this position until the colour is again slightly changed to a beautiful damask-rose tint, which should appear uniformly all over the surface of the plate. It must then be quickly removed to the black slide-box of the camera, and is ready for immediate use. If, however, it is carefully excluded from light and air, the peculiar sensitiveness of the plate will be little impaired, although it remained unemployed three or four hours; but it cannot be relied on after a much longer period. Some, indeed, have asserted that the plate is rendered *more sensitive* by being prepared the previous day: this, however, is an absurdity. We have repeatedly tried the effect, and have invariably been confirmed in our view by the result. In hot summer weather, indeed, even after one hour, we cannot with any degree of certainty use the plate without first exposing it to the iodine for a second. The pictures produced by the above directions have their deep shades of the blackest and best description, and the whites very clearly and distinctly brought out. The process possesses the advantage also of giving an extremely sensitive coating to the plate. To give your pictures that softness and *creaminess* (if we may so express it) of appearance that some admire, it will be necessary to deepen the colour slightly. In the first iodising process, proceed at once to the deep rose colour; over the accelerating substance get the damask-rose; and in the last iodising bring it to the *steel-blue* colour. Some prefer operating without putting the plate the second time over the iodine, supposing it rendered more sensitive by so doing, and they immediately transfer it from the accelerating liquid to the dark box of the camera; this plan may be safely followed only when the bromide of iodine is used as an accelerator.

It may not be amiss here to point out the best means of accustoming the eye to the instantaneous appreciation of the beautiful gradations of colour that the plate necessarily undergoes in the process of iodising. Spread a small quantity of soap, dissolved in spirits of wine, upon a piece of common flint glass. Breathe upon this through a piece of glass tubing, when a succession of prismatic-coloured rings will appear. In like manner, as is the case with thin laminæ of air, all transparent bodies deposited in thin layers reflect colours which vary in degrees according to their strata. We may, therefore, assume as a general law that the deposition of the iodine upon the plate must conform to the following order, which, it will be seen has some relation to the prismatic succession of colours:—A *pale straw* colour; a *yellow*; a *dark yellow* or *orange*; a *rose* colour, more or less dark in tint, or *red violet*; *steel blue*, and *indigo*; and, lastly, *green*. After obtaining this last-named colour, the plate re-assumes a light yellow tint, and continues to pass successively a second time (with some slight alterations) through all the above-enumerated shades. But, if the process is allowed to pass beyond the *steel blue* of the first grada-

tion, the plate will have been rendered much less sensible to the action of light in the camera; and a picture obtained on such a plate will appear very dull and defective.

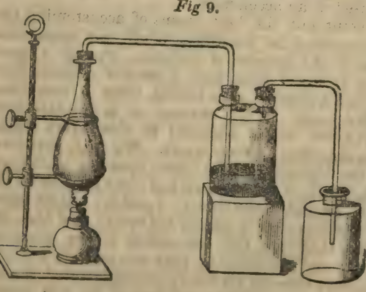
The time required to conduct this portion of the process with success will vary, according to the strength of the mixture in great part, from five to twenty or thirty seconds. The object to be attained is the colour which we have previously indicated as necessary; and one trial will readily enable the operator to determine the exact period requisite, in the first instance, to effect this object. It will be found, however, that, after a few hours, the accelerating mixture will become gradually weaker, and, therefore, it will be necessary to increase in proportion the time of subjecting the plate to influence.

One thing must carefully be avoided—the getting *too much of the accelerative* upon the plate. We have ourselves been excessively annoyed by failures proceeding from this cause; although, by having the plate under the eye, the colour will generally determine when sufficient has been deposited, so that by a little precautionary attention, this annoyance seldom need occur. Indeed, too much care cannot be taken to get the relative quantities of iodine and bromine correctly upon the plate, for, if there is too small a quantity of bromine, in proportion to the iodine, the plate will not be very sensitive to the light, and it will be impossible to bring the picture fully out without being of a dingy blue appearance. Again, if too much of the vapour of bromine be applied, the sensitiveness is diminished also, and the plate appears covered by a mist; the mercury deposits itself too readily on the parts it should not, and the picture will be very flat, dull, of a greyish appearance, and generally solarised. There is a certain quantity of the sensitive mixture required for each tint of iodine, and this exact quantity the photographer must obtain before he can expect a favourable result. If the full equivalent of the bromine, or sensitive mixture, be applied, the picture will develop itself *very perfectly*—every part will appear distinct and white, and the shadows very deep and black.

We next come to consider the different solutions made use of as an *accelerator*. The first and, perhaps, the one more generally adopted is a solution of bromine. To prepare this, we put into a bottle of distilled water an excess of bromine, which, being shaken together for some time, will become a *saturated solution* of bromine. One drachm of this to eight ounces of water will be sufficient to pour into the pan at any one time. The colour of the solution should be a pale straw colour.

The next article is a solution of chloride of bromine. This may be prepared by passing a current of chlorine gas through a vessel containing a solution of bromine, by means of the apparatus *fig.* 9. A mixture of two parts of hydrochloric acid, and one of the black oxide of manganese, should be placed into the flask A. To this flask a bent tube is adapted, passing through an opening in the two-necked bottle B. This tube should dip into a little bromine solution placed in the bottom of it; another tube should proceed from this, and just dip below the surface of some water in another vessel, C. A very

Fig 9.



gentle heat is then to be applied to the flask A, and a current of chlorine gas will quickly pass through the bromine solution, in B : in a short time the bromine will change colour, and a volatile yellowish-red fluid is the result.

Luting will be required to prevent the escape of the chlorine gas, which, being very deleterious, should on no account be inhaled by the operator. One or two drachms are to be employed to about eight ounces of distilled water, so that the mixture may appear of a pale yellow colour in the pan.

A more convenient way of preparing the chloride of bromine is to mix two drachms of a saturated solution of bromine with fifteen drops of hydrochloric acid and ten ounces of water. All these mixtures require to be kept in stoppered bottles.

The bromide of lime, a powder, recommended by Mr. Bingham, we believe to be very good. It may be compounded by allowing bromine vapour to act upon hydrate of lime for some hours. The best method of doing this is to place some of the powder of the hydrate of lime at the bottom of a flask, and then put some bromine into a glass cup or, supported a little above it ; the lime will gradually assume a beautiful scarlet colour. As heat is developed during the combination, it is safer to place the flask in water.

M. Claudet uses the bromide of iodine. This compound may be prepared by introducing about a drachm of bromine into a small bottle ; to this should be added iodine in small quantities, until the bromine will dissolve no more. A few drops of this saturated solution only will be required to be added to half a pint of water, to make it of a bright yellow colour. This mixture is constant in its action, and the plate does not require to be placed the *second* time over the iodine. M. Claudet uses this mixture very largely diluted, so that nearly half an hour is required to apply the proper quantity of this vapour. He states that by this plan there is a greater certainty of obtaining uniformity of the mixed vapours upon the plate : a second or a minute more or less does not make that difference to the plate that it would if a stronger solution were used. He employs several small earthenware pans, not inclosed in any case, to hold the solution, and prepares many plates at one time, exposing all about the same time to the vapour.

But the mixture we more particularly recommend is Wolcott's American Accelerator.

This mixture cannot be said to have a "fair trial," when used in a pot having a *cover* which has to be *lifted* off, instead of being provided with the previously-recommended *sliding* cover. Cold weather, as our experience testifies, is also unfavourable to this part of the process; the combination of the iodine with the silver is then very tedious and imperfect, and the most careful employment of the *accelerator* will scarcely prevent it from attaching the silver, instead of quickening and combining with the iodine. The temperature of the apartment ought not, therefore, to be lower than 60 degrees—*cold* and damp being equally deleterious. The mixture is prepared for use by stirring, with a glass rod, about sixty or eighty drops in half a pint of water, and allowing it to stand for an hour previous to exposing the plate over it.

An exposure of the iodised plate for about five seconds over this fluid will be sufficient, and the pictures produced by it are unequalled in brilliancy and clearness of appearance; but the principal advantage to be derived from its employment we consider to be the extreme sensibility it induces, and the consequent rapidity with which the operation may be conducted upon the plates in the camera—the critical moment of the daguerréotype. We are convinced that there is nothing in use at all equal to it.

Hitherto, the operation of iodising has been described of so delicate a nature that it was thought absolutely necessary to perform it in a totally darkened room. We are certain, from practical experience, however, that it

may be conducted in an ordinary room, or even out in the open air, with this precaution only, that, if under a powerful light, before being quite ready to transfer into the dark box, it will but require removal into a shaded place and to be preserved from *direct* contact with the rays of light. We are led to believe that the plate is rendered more sensitive by being examined, and the colour noticed in the broad daylight, after its exposure to the sensitive mixture, always taking the precaution to place it for a second or two over the iodine in the dark room; or, by merely placing a bright yellow tissue-paper before the window of the room in which we prepare our plates, all the *chemical rays* of light will be effectually excluded, and no danger of spoiling need be apprehended.

It is very useful to be thus enabled to restore a prepared plate, as by some accident we may get the plate exposed, or the object may move after the focus of the lens has been for too brief a period directed to it. On such occasions most persons repeat all the tedious processes of cleaning, polishing, and iodising; instead of which, it is merely necessary to place the plate for two or three seconds over the iodine, when it will be rendered again in a fit state for the operator to proceed, with a hope of being more successful.

It was a knowledge of this fact, and a little consideration of what other purpose it might be rendered available, that induced Mr. Wolcott to apply for a patent for a process whereby the gradations of light and shade shall generally be rendered (as he describes it) "more true to nature, and which shall prevent the picture from being as much injured from any error in the time of its exposure to the action of the light in making the impression as it otherwise would be."

The following is an account of the operation:—

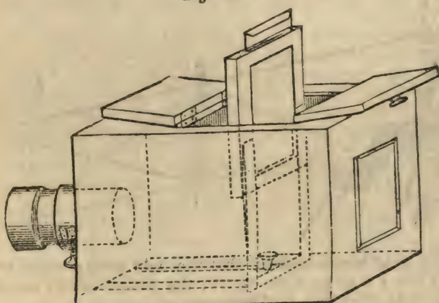
"When it is supposed that the plate has been sufficiently long exposed to the action of the light to produce the picture, if it was immediately exposed to the vapour of mercury, instead of arresting the operation, the light is allowed to act a longer time on the plate; the plate is then removed and exposed to the vapour of iodine, bromine, chlorine, or a mixture of any of them, or to any other vapour or vapours that shall have the effect of lessening the deposit of the mercury when the plate is afterwards exposed to it. And if the more volatile substances, such as iodine, bromine, or chlorine, are used, they should be very much diluted with water or otherwise; in using iodine, for instance, one part of a saturated solution in water, mixed with 200 parts more of water, will generally be found sufficiently strong: whichever substance is used it should be put into a vessel with a sliding cover, extending so far beyond the side of the vessel as to have an opening in the part beyond of nearly the size of the plate, with a rebate large enough for the plate to go into and nearly through the cover. When the plate is placed in the cover it may be slid over the vessel without allowing the vapour to escape, thus ensuring greatregularity in successive operations; otherwise the vessel may be covered with a porous earthenware or other cover, which would allow the vapour to pass through it and act on the plate, which should be brought very near to its upper surface. If the vapour is applied through the cover it should be much stronger. In the case of iodine being used, it may be put in in the form of crystals. As the proper time of the plate's exposure to vapour, after the impression is made, will be varied so much by the extra time that the light has been allowed to act on the plate, by the strength of the vapour, by the closeness of the vessel, by temperature, and by other circumstances, no exact time of exposure can be stated. It is recommended, first, to get an impression which is known to be overdone, and expose it for a short time to the vapour, and then to the mercury. If the picture when formed is still found to be overdone, the next impression tried (being as much overdone as the last)

must be exposed longer to the vapour, or the vapour must be made stronger; by this means a few experiments will give the proper time of exposure, which will serve as a guide for all future operations. If the impression is found to be entirely or too much obliterated in the trial, it shows that the vapour is too strong, or the exposure continued too long. The vapour of iodine is recommended as being the most convenient in practice. The extra time of exposure of the plate to the action of the light may be from one quarter longer to several times as long, according to the nature of the object to be copied: thus, if it is a living object, it will not do to increase the time so much on account of the risk of moving; and in cases where the extreme of light and shade are very great, a much longer time should be used, that the lower lights may not be obliterated by the application of the vapour."

EXPOSING THE PLATE IN THE CAMERA.

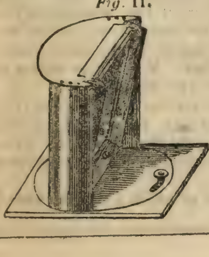
We have now arrived at that stage of the process in which the *prepared plate* is to be *exposed* to the action of light in the *camera*. *Fig.* 10 shows

Fig. 10.



the American form of camera, modified by Messrs. Knight and Sons. It is a very convenient arrangement; admits of great variation in the length of focus, and may be used for copying daguerréotypes where the focus is required to be of the same length as the object to be copied is distant from the object-glass: in this case the image formed on the ground glass will be of the same size as the object at which the camera is directed. The plate frames in this camera are so made that the plate can be used in either a horizontal or vertical position, without the trouble of turning the camera on its side; and a considerable number of these frames, containing the prepared plates, can be packed within the camera.

Fig. 11.

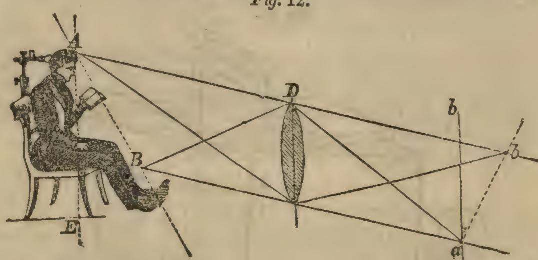


Another, and a very important improvement in this camera, has been made by the last-named gentlemen—namely, a readier and less expensive contrivance for altering the position of the plate with respect to the object-glass, by which means two objects, differing slightly in their distance from the object-glass, are brought to the same focus on the ground glass or plate. *Fig.* 11 represents the moveable frame for the purpose.

We shall endeavour to explain the advantage derived from occasionally placing the plate out of

its upright position. It is well known that the focus of any object varies according as it is more or less removed from the object-glass; thus, the proper focus of an object near the lens will differ from that of one placed immediately behind it. Thus, in *fig.* 12, let the line A B represent an object situated obliquely to the lens D: the point A will have its focus behind the lens at *a;* the point B being nearer the lens will have its focus at a greater distance, at *b*. Now, by the ordinary arrangement of camera, only one of these points, as *a*, could be obtained correctly in focus, the line *a b* representing the ground glass; but by making the back of the camera moveable, we can place the ground glass as indicated by the dotted line *a b*, therefore both these points, *a b*, or any part of the object on the line A B, will thus be in correct focus, and both the face, knees, and hand of the sitter drawn in the figure, will be properly represented. This is, to a certain extent, a great advantage, and particularly so with a short focus lens having a large opening:

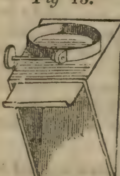
Fig. 12.



but it will also be at once perceived that the only parts *properly* in focus will be where the line A B touches the figure; the pattern of the waistcoat would, in this instance, be slightly out of focus.

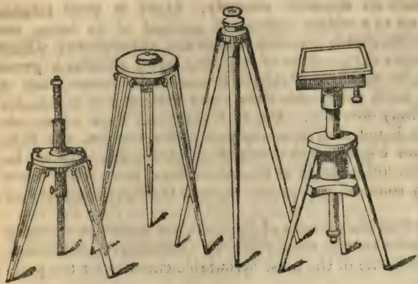
Fig. 13 represents a mirror for reversing the sides of the image, and is to be fitted on to the end of the object-glass: this is necessary when we wish the objects represented to appear in the same position as they do naturally. Thus, if we point the camera at a man writing, in the representation his pen will appear to be held in the left hand; but if the mirror be used, the sides will be reversed, and the pen appear in the right hand. A glass prism is sometimes used for this purpose, but it is very much more expensive, and difficult to obtain perfect and free from striæ. It is true, there are two reflections, and therefore two images formed on the ground glass by the mirror—one image being formed by reflection from the surface of the mercury at the back of the glass, and the other a faint image from the surface of the glass; but, practically, this is of little importance, for the latter image is seldom of sufficient intensity to impress the plate. When the mirror is used, it doubles the time of exposure of the plate in the camera.

Fig 13.



Figs. 1, 4, 15, 16, and 17 show four different forms of the camera stand: the two middle ones possess the advantage of portability, hence they are best adapted for the tourist taking views from nature; the first, however, is the better suited for taking portraits or figures from life, and the latter combines the advantages of both.

The camera being fixed firmly opposite the object of which a copy is desired



its focus must be carefully adjusted by the rack and pinion, until a perfectly clear and distinct image be presented on the piece of ground glass, which, of course, should be placed in exactly the same position as the plate is to occupy, the *ground* side of the glass corresponding with the prepared surface of the plate when in use. The desired focus obtained, the light may then be shut off, the ground-glass slide withdrawn, and the slide containing the plate introduced in its stead, and the light allowed to fall upon the plate through the lens. The time requisite for the remaining of the plate in the camera mainly depends on the intensity of light acting upon the object to be produced on its surface; the season of the year, the time of day, the brightness or clearness of the atmosphere, are, of course, to be regarded: and the *colour* of the *object* itself must also be taken into account, since all *colours* are not equally photographic. For instance, yellows, vermilion, and green have scarcely any action upon the sensitive plate, whereas blues, violets, and lakes have a very energetic one.

The photographic intensity very materially decreases in proportion as the sun approaches the horizon. Thus from 11 to 1 o'clock a mere fraction of a second will suffice to produce a picture (a landscape or edifice) in the open air, with a short focus lens, whereas at 5 or 6 o'clock in the evening from five to ten seconds will be occupied in producing the same effect.

All this seems, at first sight, very embarrassing; but, in reality, the difficulty can be readily overcome by making a few careful experiments, to become acquainted with the working powers of the apparatus used. When, indeed, an operator has acquired some experience, conjoined with a perfect knowledge of his instrument, he will be enabled readily to determine, without fear of failure, the time during which the plate ought to remain in the camera.

The following are some of the indications by which the operator will know whether the plate has remained too long or too short a time in the camera:— The exposure will have lasted too long, and the impression be completely *burnt up* or *solarised*, when all the objects reproduced are apparent, but with an inverse intensity to that which they had in nature; that is to say, the whites have become blueish, and the parts which should be black approximate more or less to white. If the plate has not been subjected long enough to the action of light, the impression will be vague, its outlines faintly marked, and the details either indistinct or not at all apparent.

So many conditions are requisite to a successful operation, that, indeed, it might be said that failure is the rule, and success the exception. The operator has constantly to overcome new difficulties, and the greatest is, perhaps, the want of power to appreciate the amount of operating rays existing at every moment.

"When the daguerréotype was first discovered, it was expected that southern climates would be more favourable than northern for the process, and that, in countries where the sun constantly shines, the operation would be considerably shorter. This has not been proved to be the fact, and the following

reason may be given for such an apparent anomaly. Light is more intense in the northern latitudes up to a certain degree, on account of its being reflected in all directions by the clouds disseminated in the atmosphere; whilst in the drier climates the open sky, instead of reflecting light, absorbs a great quantity of it. Of course, in speaking of clouds, it cannot be meant that a completely covered sky is more favourable than a sky without any clouds, for in this case the sun is entirely obscured. But still there are days when, although the disk of the sun is not seen from any part of the horizon, the thin clouds allow a much more considerable quantity of photogenic rays to be diffused and retained in the lower strata of the atmosphere than when there are no clouds, and that by some imperceptible vapours the light has a yellow or red tint."

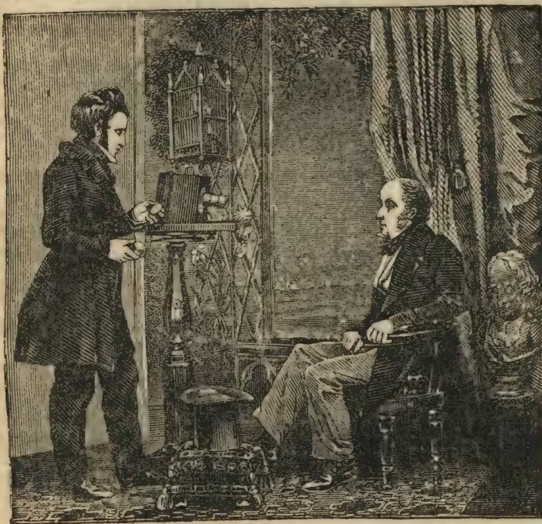
It was at first expected that the climate of England, and countries similarly situated, would be unsuitable to the daguerréotype operation; nevertheless, it has turned out that this is one of the most favourable climates for the practice of the process.

"There is another curious fact connected with the photogenic operation, which is, that on the summits of high mountains the action of light upon the plate is not so intense as in the lower regions. A clever operator was sent two years ago into Italy to take daguerréotype views of the most interesting spots of that country. After having visited Rome, Florence, Naples, Venice, and other towns, and succeeded in producing a beautiful and curious collection, he wished, in crossing the Alps on his journey home, to obtain some views of the glaciers and other Alpine scenes; but, what was his surprise in finding that he could not obtain in one hour, and one hour and a half, in full sunshine an image of these snowy mountains, having the same degree of force and distinctness as views which he had produced in less than fifteen minutes in the lower countries which he had just visited. The skill of this operator was great; he tried several times, and always with the same difficulty, and at length he abandoned the idea of bringing with him a perfect specimen."

The cause of this fact may be ascribed to the reason given before, that a sky without clouds absorbs a great quantity of light, and that upon high mountains the rarity of the atmosphere would occasion a certain loss of light. But it remains to be ascertained to what degree the light is absorbed, or otherwise affected by the variations in the density of the air at great elevations above the surface of the earth.

It has been found that that part of the spectrum which gives the most light (the yellow ray), will not produce chemical change. Under the influence of the brilliant light of equatorial climes it has only been with the greatest difficulty that photographic pictures could be produced, owing to the excess of the yellow rays over the blue in the solar beams of those regions. If we interpose between any object and the sun a chrome yellow glass, although it will be most brilliantly illuminated, and throw a beautiful image in the focus of the camera, it will be found impossible to copy it, even by the most sensitive processes, in many hours.

An explanation of these remarkable effects has been attempted, on the hypothesis that the principle producing the remarkable chemical changes, to which we have been referring, is not light, but some power associated with it, which does not affect the eye or produce colour: and it would appear, from he very interesting experiments made by Mr. Hunt, that we can separate, to a certain extent, these influences one from the other by coloured media.



TAKING THE PORTRAIT.

Before the invention of Photography, opticians constructed apparently perfect instruments by the combination of glasses of different degrees of refrangibility and dispersion, thereby concentrating at the same focus all those rays of light by which our vision is enabled to perceive objects. But Photography required different conditions, for the purpose of bringing to the focus of the visual rays some extreme rays of the spectrum, which are the only chemical or acting rays, and which, in the formation of the visual image have scarcely any value; and it was found that in none of the best constructed achromatic object-glasses did the *visible* and *chemical* focus coincide.

Voightlander, an optician of Vienna, was the first to set about correcting this deficiency, which he was enabled to do from the calculations made especially for him by Professor Petzval; he has been most successful in making combinations of object-glasses, of the respective diameters of 1½ in. and 1⅝ in., with full aperture, the combined focus being 5⅝ in., producing the visual image with the blue rays, and dispersing the less refrangible. Hence the foci of action and vision coincide.

But, as many of our readers may prefer combining lenses for themselves, it will be necessary to describe a few of the general Optical Principles, as far as they relate to the formation of images, and convey a correct idea of the action and relative value of lenses used in the construction of his camera, and thus enable him to make a more extended application of them to the Photographic art.

All instruments formed of one or more convex lenses produce, at a point called the focus, an image of any luminous object to which it may be directed; but every image produced by such convex lenses is reversed.

The size of the image is to that of the object as the distance of the image from the lens is to that of the lens from the object.

When parallel rays of light fall on a convex lens, those which impinge on its axis do not undergo any alteration in passing through the glass, but follow their original direction, but all the others converge after passing the lens till they meet at a certain point of the axis, which point is called the focus. But if the lens be brought nearer to a radiating point, the focus will be lengthened, and *vice versâ*.

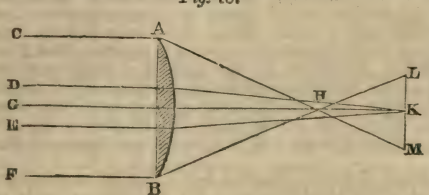
If two lenses be used of the same focus, the images produced by one may be rendered much more brilliant than those produced by the other by having the former of larger diameter; for instance, if one of the lenses were two inches and the other one inch in diameter, the former would intercept four times the quantity of light more than the latter, and it is evident the image produced would be four times as brilliant.

But care must be taken not to confound *brightness* with clearness—they are two things totally different, and the gaining of one does not depend on the other, for it is necessary, generally, to stop a portion of light from falling on the lens, by which means a much sharper picture is obtained.

Then we have both *spherical* and *chromatic aberration* to correct. Spherical aberration may be understood by supposing that the rays reflected by simple lenses have their foci situated in the same plane. But, in admitting that refraction takes place equally at every part of the lens, it is evident that those rays which are the most oblique, after being refracted, cannot intersect and form their focus in the same plane as those rays which are nearer the axis; and it is also certain that the latter suffer less refraction, and consequently converge less, and form their image at a greater distance, from which it follows, that, as all the foci do not fall in the same plane, the image will be distinct only at certain parts.

Let A B (*fig.* 18) be a plano-convex lens, and the rays C D E F emanating from the sun and falling parallel to G K on the flat surface of the glass; the rays D E, near the axis (G K), will suffer less refraction than the rays C F, and will form a focus at K, whereas the extreme rays (C F) will form their focus at H. How then, is a perfect image to be obtained with this difference of focus? If A H and B H are prolonged to L and M, where the rays meet the plane (L M) of the focus K, an image of the sun will appear surrounded with a luminous zone, to which the name of *halo* has been given, and which will appear less brilliant the further it is removed from the centre (K). The same reasoning is applicable to all the intermediate rays from C to D and F to E, and their different foci will fall between H and K.

Fig. 18.



It is very easy to verify the correctness of these rules, for if the surface of the lens be covered with a diaphragm, having a central opening, so as to allow those rays only to pass which are near the axis, a clear and sharp image of the sun will be formed at K, and if, instead of the diaphragm, a small disk be used so as to intercept the central rays, an equally clear image of the sun will be

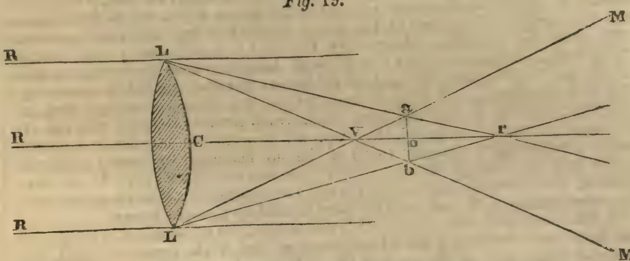
formed at H. These two experiments go also to prove what has before been stated, for, in both cases, the image is rendered more sharp, but less luminous. The term longitudinal aberration is given to the distance H K, and that of lateral aberration to the width L M.

Chromatic Aberration.—To understand what is meant by chromatic aberration, it is necessary to bear in mind that light is decomposible, or, in other words, it is the result of a combination or mixture of a certain number of colours, which are considered as the elements of white light, because they have not yet been decomposed.

All the colours which form a ray of white light are not equally refracted by lenses, and consequently cannot meet at the same focus and form a white ray; and not only does this fact explain the colouring of the image, but also the want of sharpness which it presents. The following example will, perhaps, render the foregoing more easy to be understood.

If L L (*fig.* 19) be a double-convex lens, and R L, R L, parallel rays of white light, composed of the many-coloured rays, each having a different index of refraction, they cannot be refracted to one and the same point—the red rays being the least refrangible to V; the distance V *r* constitutes the chromatic aberration, and the circle, of which the diameter is *a b*, the place or point of

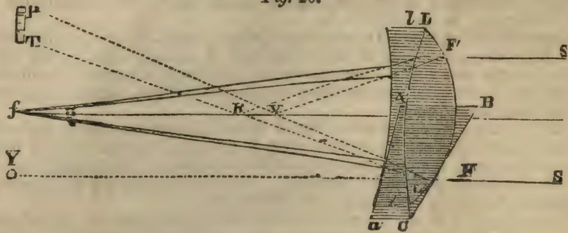
Fig. 19.



mean refraction, and is called the circle of least aberration. If the rays of the sun are refracted by means of a lens, and the image received on a screen, placed between C and *o*, so as to cut the cone L *a b* L, a luminous circle will be formed on the paper, only surrounded by a red border, because it is produced by a section of the cone L *a b* L, of which the external rays (L *a*, L *b*) are red; if the screen be moved to the other side of *o*. the luminous circle will be bordered with violet, because it will be a section of the cone M *a* M *b*, of which the exterior rays are violet. To avoid the influence of spherical aberration, and to render the phenomena of colouration more evident, let an opaque disk be placed over the central portion of the lens, so as to allow those rays only to pass which are at the edge of the glass: a violet image of the sun will be seen at V; red at *r*; and, finally, images of all the colours of the spectrum in the intermediate space; consequently the general image will not only be diffused, but clothed with prismatic colours.

It is well known that all bodies have different dispersive powers; that is, *flint glass* (the white glass of which drinking-glasses are made) and *crown glass* (the glass with which windows are glazed) have different powers of producing colour. The application of this to lenses is shown in *fig.* 20.

Fig. 20.



In this figure, L L is a *convex* lens of *crown glass*, and *l l* a *concave* one of *flint glass*. A ray of the sun (S) falls at F on the convex lens, which will refract it exactly in the same manner as the prism A B C, whose faces touch the two surfaces of the lens at the points where the ray enters and quits it. The solar ray S F, thus refracted by the lens L L, or prism A B C, would have formed a spectrum (P T) on the wall, had there been no other lens, the violet ray (F V) crossing the axis of the lens at V, and going to the upper end (P) of the spectrum; and the red ray (F R) going to the lower end (T). But, as the flint glass lens (*l l*) or the prism A *a* C, which receives the rays F V, F R, at the same points, is interposed, these rays will be united at *f*, and form a small circle of white light, the ray (S F) of the sun being now refracted without colour from its primitive direction (S F Y) into the new direction (F *f*). In like manner, the corresponding ray (S′ F′) will be refracted to *f*, and a white and colourless image of the sun will be there formed by the two lenses.

In this combination of lenses, it is evident that the spherical aberration of the flint lens corrects to a considerable degree that of the crown one, and, by a proper adjustment of the radii of the surfaces, it may be almost wholly removed. This, however, is more perfectly effected in the *triple achromatic object-glass*, which consists of three lenses, viz., a concave flint glass lens placed between two convex lenses of crown glass; but this form of the achromatic object-glass is now generally abandoned, and almost all the large object-glasses which have been recently constructed consist of two lenses only.

It must be evident, then, from what has been here explained, that a good, sharp image, free from all objections, can only be produced by a very nice adjustment of glasses of different forms and densities; and we are quite sure from experience that no English lens has been constructed at all comparable with the German, for inducing beauty of detail, correct delineation, and rapidity of operation, and, therefore, well adapted to portraiture, groups, or views.

Figs. 21, 22, and 23, are head-rests, for keeping the head of the sitter steady. This is essential to the taking a good portrait, either by the daguerréotype or calotype process. The arterial pulsation is sufficiently powerful to prevent the head from remaining perfectly at rest for the few seconds required to take the portrait, without some support.

Fig. 21.

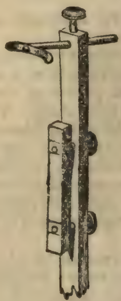


Fig. 22.

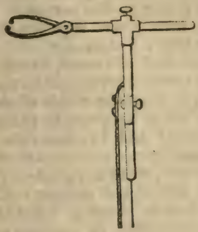


Fig. 23.

The stiff, formal, and anything but natural or pleasing expression of the daguerreotype pictures, generally exhibited, plainly indicate that they are the productions of individuals whom we must assume to be wholly ignorant of the simplest rules of art, using the term as signifying something more than the mere mechanical handling of given materials. Often are badly-painted backgrounds introduced, and these are frequently so stupidly managed as to distract attention from what should be the main point of interest, and the entire picture is thus rendered repulsive to the eye of a person of the slightest taste.

It is also, frequently a matter of complaint that portraits have not an agreeable expression, that they want artistic effect, do not possess that modelling which should give relief to all the parts and are consequently flat; now, the image of the camera obscura being without these defects, it behoves us to endeavour to discover the cause of this difference.

In whatever manner an object is illuminated by the light of day, the eye preceives instantly all the points of the object, and there exists sufficient reflected light to illuminate the parts in shadow. Suppose the parts strongly lighted to have an intensity a hundred times greater than the parts in shadow the proportion is always the same for the eye, whatever might be the length of time that the eye was fixed on the object, there is always the same relation between the strong lights, the half tints, and the shadows; but it is not the same with the effect produced on the photographic plate, the light operates gradually; at first the strong lights only are visible; by continuing the process the half-tints develope themselves; during this time the lights become more intense, and the half-shadows appear, but beyond a certain point the lights produce solarization, and if the operation be then prolonged the shadows become transparent, the parts of the object which reflect the most light have produced too much effect, the half-tints are lost, the shadows disappear, and then all the parts of the image become confused, being covered with mercury; the drawing then appears feeble—in short, nothing but a vague outline. M. Claudet, struck by these effects of the solarization of the lights, looked for means to modify them, and at length the idea occurred of using screens, covered with black velvet, to shade those parts which reflected too much light, and at the same time to retard the action until the parts in shadow had produced sufficient effect. The operator, placed at some distance from the person, was furnished with a screen in each hand to move always in the direction from which the strong light is projected, thus preventing solarization, and was enabled to produce artistic effects; in fact, these screens, in the hands of a skilful operator, might be likened to the brushes in the hands

of the painter, for it was by their use that the heightened effects of light and shade were produced in the photographic portraits.

Portraits may be taken with great rapidity in the open air—usually in from one to twenty seconds under a clear sky.

The position of the camera will, of course, be regulated by circumstances: but, generally speaking, the instrument should be placed nearly on a level with the face, care being taken to keep the whole of that portion of the person appearing on the plate as much as possible in the same plane. The direct rays of the sun are best avoided; and, to effect this, the person whose portrait is to be taken should be seated under a canopy of white calico, with a screen of similar material on either side, so as to equalise or diffuse the light as much as possible, leaving the near side of the subject rather more illuminated than the other, in order to produce a pleasing effect of light and shade in the picture, due attention being also paid to position, arrangement of attire, and so forth, with a view to *artistic effect.*

A dark drab-coloured stuff forms an excellent background. A table, books, vases of flowers, &c., may be introduced with discrimination; but much *white* should be carefully avoided. These hints being duly attended to, we may anticipate the comparative perfection in the presentation of the more prominent objects, joined to great precision in the details, with an admirable gradation of shade, which may render the photographic image a masterpiece of art or nature, or both conjointly, when the effects of which it is capable are considered.

Views.—The points from which buildings or views can be taken with the best advantage vary so greatly, that the operator must be left pretty much to his own discretion in choosing a position. As a general rule in taking buildings, monuments, &c., it is advisable to place the camera at a distance of about twice its greatest dimensions, and, if practicable, at about one-third its height. If the whole of the building or buildings be not in the same plane, select the most important portion to be most clearly defined, or take several views, in each of which certain points are brought out more distinctly. If an old and new building are to be introduced in the same picture, which should, if possible, be avoided, a black screen or handkerchief, or some other opaque body should be placed over the lens for a moment or two, so as to cut off the rays of light reflected from the brighter portions of the object, the position of which may be previously observed on the ground glass. The same precaution should be taken when the sky is very blue, or strongly illuminated by the sun. The best time for taking views is undoubtedly the earlier part of the day.

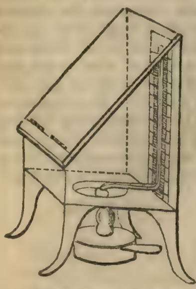
Engravings, Drawings, &c. may be copied very beautifully with a little care; the whole of the model being in the same plane, there is a little difficulty in producing a good effect. The object to be copied must be placed in a good light, taking care to have every part equally illuminated. To secure sharpness, the model is placed in open daylight, and a small diaphragm put before the lens to reduce the aperture and cut off part of the external light.

Machinery, Statuary, and Articles of Vertu require to be arranged in suitable positions, so that the light may fall upon the object most effectively.

THE MERCURIALISING PROCESS.

In withdrawing the plate from the camera, an exposure of it to the external light should be avoided, and it should immediately be conveyed to the mercurialising box (*fig.* 24), and there be submitted to the vapour of mercury; into the cup at the bottom of the box, about two ounces of quicksilver, tied up in a piece of chamois leather or linen rag, having been previously introduced. The plate is to be placed in the proper position, and the mercury in the cup gradually heated by means of a small spirit-lamp standing under it, until the thermometer indicates about 140 or 150 degrees of heat. It will be necessary to continue this heat from seven to about fifteen minutes, or even

Fig. 24.



longer, to develop the picture, which may be examined from time to time by the aid of an artificial light. This operation is generally rendered more certain by the mercury being heated, before the plate is introduced, to about 120 degrees, in order that any damp air that may have collected in the box may be expelled. Indeed, this will shorten the time required in the conduct of this portion of the process. Should it so happen that no outline be visible in about three or four minutes, it may arise from one of the following causes—either the picture has been removed too soon from the influence of light in the camera, some atmospheric or chemical vapour floating in the room has affected it, or the mercury may not havebeen sufficiently heated. It must, nevertheless, be borne in mind that the details are usually much better developed when the picture has been brought out slowly, and with a degree of heat never exceeding 160° Fahr. Attention must be paid to keeping the mercury-box free from dust, and any mercurial particles adhering to the sides and top must be previously well removed by the aid of a stiff brush. A small *painter's tool* will answer the purpose best. The reason for this precaution is, that otherwise some small globules of mercury might be detached and fly upon the face of a good picture, on the slightest movement being accidentally given to the box.

We find in this part of the process that those parts of iodised silver plate, upon which the light has acted with most power, receive, in the exposure to the vapours of mercury, the largest quantity of that vapour over their surfaces, and the gradations of light are marked very beautifully by the thickness of these mercurial films.

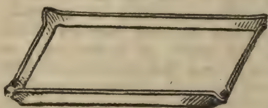
It is to be observed that the mercurial vapour does not enter into combination with the surface of the plate, unless it has previously been exposed to the influence of light. A plate exposed to the mercury before and after it had been coated with iodine, was not affected in its after operation in the camera by this premature exposure; so that it is absolutely necessary that the mysterious influence of light should be exerted upon the plate before any degree of affinity exists between it and the vapour of mercury with which it is brought in contact.

The picture may be developed by submitting it to the action of the yellow rays of light, by covering the plate with a piece of yellow glass, without any exposure to the action of the mercury; the effect being so analogous, it would be difficult to decide which had been produced by the mercury and which by yellow light. It is, indeed, most marvellous, that yellow rays should produce upon the plate those white microscopic dots which were assigned only to the combination of mercury. Dr. Moser's theory respecting the formation of the image by the mercurial vapour, being, that this vapour developes latent yellow light, and that it is only as continuating yellow rays that the mercury produces the picture.

THE HYPOSULPHITE BATH.

When the picture is fully developed, and the whites clearly brought out, the plate is to be removed from the influence of the mercury, and allowed to cool a short time before plunging in the hyposulphite of soda bath, previously prepared by dissolving about one drachm of the chrystalised salt in a quarter of a pint of distilled water in a shallow pan (*fig.* 25). Here it will be suffered to

Fig. 25.



remain a few minutes until the iodine be removed from the plate, the operator agitating the solution to facilitate this object. From hence it is to be taken and well washed in a basin of clean water, and then conveyed into the washing and drying apparatus (*fig.* 26). This consists of *a small filter* or barrel containing distilled water (A), with a stop-cock which allows the water to flow into an enclosed copper trough (B), passing off at a spout. The flow of water is then turned off and the spirit lamp (C), with a large flame, applied, which quickly bringing the water in the copper trough to near the boiling point, the plate must then be withdrawn, by slowly pushing up the small handle, connected with the wire frame on which the plate rests in the interior of the trough, and blowing from the mouth upon the plate as it appears, to drive off in vapour the adhering globules of water, thus entirely preventing the spotting so frequently observed when hot water has simply been poured over the plate. Or the simplier and cheaper form of apparatus (*fig* 27) may be used for this purpose. *a* is a vessel of sufficient size to take the largest plate, but not more than half an inch in width; it is best made of copper or brass, tinned or plated inside, which must be kept perfectly clean: hot distilled water is poured into it, and the temperature kept up by the spirit lamp. The plate, supported by the holder (*c*), is immersed and then gradually withdrawn: at the same time the operator should gently blow upon the surface. Small plates are readily dried by holding them by one corner with the pliers, and pouring hot distilled water on them, applying the spirit lamp to the back at the upper corner, at the same time facilitating the operation with the breath, passing the lamp gradually downwards, finishing at the extreme corner. The last drop may be removed by a little bibulous paper. The film of water must dry off evenly, and leave no drop behind on the surface, for this would infallibly cause a stain which it would be difficult to remove. Should a drop separate from the rest, it is better to return the plate into clean water, and commence again the drying operation. If the plate be quite clean, there will be no difficulty in drying off the picture; but if there is the smallest quantity of grease, either on the

Fig. 26.

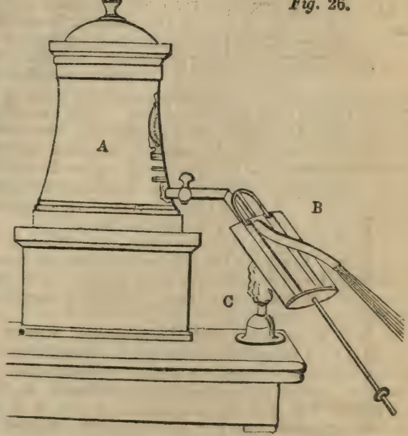


Fig. 27.

plate or in the water, or communicated by the fingers, it will be impossible to get the water off properly. The only plan to adopt in this case is to pour over the plate a little strong alcohol, and *slightly* wipe the plate at the same time with a camel's hair pencil: the alcohol should then be washed off with water until no striæ appear on the plate, and then another attempt made to dry the picture. An old picture, injured or stained by exposure to air, may very often be cleaned by washing it in a solution of the cyanide of potassium, at the same time passing a soft camel's hair pencil over it: it should then be washed and dried as before.

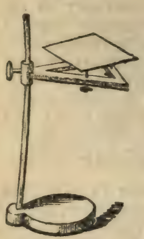
A weak solution of the cyanide of potassium will as effectually remove the iodine from the plate, after taking it out of the mercury, as the hyposulphite of soda, should the soda not be at hand.

The hyposulphite crystals should be very clear and bright, the brown lumps being rejected; and it should be carefully ascertained that they contain no excess of sulphur, or, in other words, the operator must not obtain a *sulphate* instead of a *sulphite*, or he will observe numerous blueish and milky spots appear in the subsequent process, which, in a short time, will spoil a picture.

FIXING THE PICTURE.

If this is intended to be effected immediately, it will be sufficient upon withdrawing the plate from the hyposulphite solution, to sluice it abundantly with water, and place it on the fixing-stand (*fig.* 28)—a small upright stand, with adjusting screws, to allow of the plate resting on a perfect level. Then so much of the solution of the chloride of gold and soda as the plate will contain should be poured upon it. The spirit-lamp is then to be held under all parts of the plate successively until it becomes thickly studded with small bubbles, and the image begins to assume a dark appearance. In one or two minutes afterwards it acquires a great degree of intensity. The lamp must now be removed, and the plate left for a few minutes until it has become somewhat cool. The liquid being then poured off, the plate should be put into the washing apparatus, and dried with the spirit-lamp as before directed.

Fig. 28.



In the operation we have just described the following phenomena have taken place:—Silver has been dissolved, and gold has been precipitated upon the silver, and also upon the mercury, but with different results. The silver, which by its polish forms the dark parts of the picture, is in some degree browned by the thin coating of gold which covers it, whence results an increased intensity in the black parts. The mercury, on the contrary, which, under the form of infinitely small globules, forms the whites, increases in strength and brilliancy by its amalgamation with the gold, whence results a greater degree of fixity, and a remarkable augmentation in the light parts of the image.

The solution of the chloride of gold and soda is prepared in the following manner:—Take seven grains of the chloride of gold (weighed very quickly in glass scales, as it is an extremely deliquescent salt), dissolve in a quarter of a pint of distilled water, and twenty-one grains of the hyposulphite of soda dissolve in another quarter of a pint of distilled water; then gradually pour the solution of gold into that of the soda, stirring it all the while with a glass rod. The mixture, which is at first of a slightly yellow colour, soon becomes perfectly limpid. Should this solution change colour, or have deposited any brown precipitate at any time, it must be immediately rejected, as it will be no longer fit for use; to avoid which it will be better to keep it perfectly excluded from light, and only a small quantity should be mixed at any one time.

It is often an advantage to use the gold solution of one-half the strength before recommended: there is less risk of the film of gold becoming too thick and breaking up, as is often the case when the heat is continued too long, Another advantage is, that it enables the operator to "*gild down*" a stain which often appears at the beginning of the gilding process; for by continuing the heat there is very little danger of exfoliation of the gold, and the stain very often disappears. The operator will soon discover the kind of stain which will disappear by continued gilding. If there are any traces of oil left on the plate by the cleaning process, white stains will appear; these cannot be got rid of by continuing the gilding; they get worse, and if they appear, it is very little use proceeding farther with the proof, for it will only render it more difficult to clean.

Solarization may often be removed by long application of heat, using the solution weak.

There has been recently introduced from Paris a white salt of gold (*sal d'or*): it is not so liable to spoil, nor so difficult to manage as the chloride of gold and the result of the use of which upon the picture is equally brilliant.

It has also been tried, and we believe with success. to fix the image in a silver bath, prepared by dissolving cyanide of silver and cyanide of potassium in distilled water. This is the process adopted:—Upon removing the picture from the mercury, it should be plunged into this silver bath, in which it should remain for a few seconds until the sensitive coating is dissolved. A galvanic current being then established in the usual way with the battery, in eight or ten seconds the picture will be fixed.

Its advantages are stated to be—1st, that it gives great brilliancy to the lights, and the solarised parts become very white; 2nd, that, silver being a photogenic metal, the plates may be easily reprepared for use by rubbing with dry tripoli; 3rd, that if, over a picture, when taken from the mercury, or after being fixed by silver, concentrated hyposulphite of soda solution should be poured, and the liquid brought nearly to a boiling point, the picture gradually assumes the richest tints, passing successively from yellow to red, and from red to blue; the zinc pole determines these colours in the cold at the points near it, pictures already fixed by chloride of gold giving the richest colours.

This process is not very unlike one proposed by Professor Page, of New work. In a course of experiments made by him to determine the effects of oxidation upon the surface of photographic pictures, that gentleman arrived at some very beautiful results, and adopted the following method for mixing, strengthening, and colouring his impressions.

After taking and washing his picture in the usual manner, he plunged it in a bath of *cupreous cyanide of copper*, and by galvanic agency a very light deposit of copper was precipitated upon it, only just sufficient to change the colour of the plate; then washed very carefully with distilled water, and heated over a spirit-lamp until the light parts assume a pearly transparent appearance. He also found that, according to the depth of oxidation produced upon the surface, various colours were the result; and one remarkable effect is the great hardening of surface, and that it is as little liable to change as the fixing by gold.

For landscapes it may have a pleasing effect; and, by adopting some of the recent inventions for stopping out the deposit of copper, the green colour may be made to appear stronger wherever desired. In some pictures a curious variety of colours is obtained, owing to the varying thickness of the deposit of copper, which is governed by the thickness of the deposit of mercury forming the picture. To succeed well in the fixing and in the production of the pearly appearance, the picture in the first instance should be carried as far as possible without solarization, the solution of the hyposulphite of soda em-

ployed should especially be pure and free from the traces of *sulphur*, and the plate should be carefully washed with distilled water both before and after it receives the deposit of copper.

Mr. Fox Talbot also describes a process for colouring the pictures by the battery, and making very economical plates for the process. It is as follows:— A smooth surface of steel, platina, or other suitable metal, is coated with an extremely thin layer of silver. The silver is then made sensitive to light by the usual method, and a photographic image is received upon it. The plate with the image is then placed in a horizontal position, and a solution of acetate of lead in water is poured upon it. A galvanic current is then made to pass through the plate and the solution, which causes a coloured film to precipitate upon the plate.

In our opinion colouring a beautifully-delineated photographic picture spoils it, or, at all events, is akin to daubing an exquisite line engraving with gaudy colours; possibly, however, the reader's taste may differ with our own in this particular, and he may fancy that a slight degree of colour renders the picture more attractive to the eye. We must admit that some we have seen from the hand of a French artist, M. Manson, have presented all the appearance of an exquisitely-finished miniature painting upon ivory. This degree of excellence, of course, requires the hand and taste of a skilful artist; but we may state that the following mode of proceeding is the one recommended by the above-mentioned gentleman. He employs the following colours:—

Flesh tint.	Lemon.
Plum.	Brown.
Carmine.	Scarlet.
Green.	Grey.
Sky blue.	Dark blue.
Lavender.	Colour for lips.
Orange.	

The Colours.—These are always used in an impalpable powder, and are expressly prepared for the purpose.

Brushes.—These should be either of camel or sable hair of the best manufacture: about three different sizes are required for colouring, and an extra one, of the larger size, for softening down the background. The former, before being used, should be briskly agitated in clean water, and then drawn between the lips of the operator to fine points; they are then allowed to dry perfectly, when they are ready for use, and the finest touches can be coloured with them.

The Plate.—The daguerréotype picture to be coloured should have been fully developed by the mercurial process (this is a very important matter); it must also be gilt, or, as it is usually termed, fixed. A full deposit of mercury tends to make the colours adhere better, and gives additional brilliancy. The artist commences his work by breathing over the surface of the plate, but allowing it to dry perfectly before applying the colours. To facilitate the evaporation of the moisture, an elastic bottle (properly mounted) will be found very convenient. This instrument is also useful for removing any superfluous colour or dust from the plate. the practice of blowing with the mouth must be carefully avoided.

Putting on the Colours.—The colours are taken up on the extreme point only of the brushes (prepared as described—to save time a good supply of these should be ready at hand): they are applied to the plate by a circular motion, using the smallest possible quantity of colour at a time. The deeper tints being obtained by repeated application.

Portraits.—After the first flesh tint has been spread evenly over the face and other undraped parts, the deeper tint for the cheeks is put on, the lips being then put in with the lip colour; and should this not be sufficiently

bright, as is sometimes the case in children, a little carmine or scarlet will bring them to the desired point; previous, however, to using these last-named colours, it will be well to breathe again on the plate and allow it to dry as before mentioned.

Draperies.—The lighter parts should be first coloured.

Sky Background.—For putting in this, one of the larger pencils should be used, and the blue carefully put on by a circular motion: none of this colour must be applied where clouds are to be represented—these are afterwards put in. The strong lights are produced by smoothing down the tint with a finer pencil. Skies are the most difficult part of the daguerréotype to colour with effect, being of necessity left to the taste of the artist.

Lace, Embroidery, &c.—These are put in best with artists' cake colours, the same as are used for miniature painting. They require great lightness of hand, and should be applied as dry as possible.

Gold and Silver.—These also require the greatest care in applying them to the plate as directed above, by slightly moistening them.

This mode of colouring is so far preferable to any other yet suggested, that it admits of the easy and clean removal of *over colouring*, by the simple employment of a clean brush or an elastic gum bottle—articles which should be constantly within reach. If, therefore, the complexion should be painted too rubicund, or the attire and so forth be spotted by droppings of the flesh colour, either may be speedily removed by the aid of the brush, or by a puff of the elastic gum bottle; the portrait remaining uninjured, and the artist enabled to "put on" or "take off" the colour until he has produced a pleasing effect.

We are aware that it has been stated that some persons have produced the natural colours in their pictures during the process; but we do not place much reliance upon such assertions. The possibility of ever obtaining pictures by this process representing the true colouring of nature, appears to admit of much doubt. Colour is a peculiar inherent vital principle; and we invariably observe the delicate, the beautiful, the brilliant hues gradually fade away with the loss of that vital wondrous power.

The picture may now be said to be ready for framing; a great variety are usually kept in the guilder's shops, and may be purchased for a small sum. It is advisable to secure the edges of plate, mat, and glass with strips of moistened gold-beater's skin first—the better to protect the picture from dust and the action of a dirty atmosphere upon the polished metallic surface.

THE MULTIPLICATION OF PICTURES.

It has been urged as a very great objection, that photographic pictures do not admit, as the calotypes, of being reproduced or copied; but many improvements have suggested themselves to remove this difficulty to the multiplication of a good or valuable proof. Perhaps the best yet pointed out was the last of Wolcott's inventions, relating to a camera, in which photographic pictures on polished plates may be copied by the scattered light from the surface of the plate, that portion of the light which is reflected from the polished surface at the same angle at which the incident rays fall (according to the laws of reflection of polished surfaces) being prevented from entering the lenses of the camera; and in which camera pictures that are distorted in the perspective by reason of the camera in which they were taken making an improper angle with the horizon, either accidentally, or in order to take in parts of a view which otherwise would not be seen, may be copied in true perspective.

If the glasses are placed at equal distances from the picture and the plate on which they are to be copied, the copy will be equal in size to the picture to be copied, and, at any other distances, that will be the largest which is farthest from the glasses. In all these changes the focal distance must be carefully

preserved, by changing the position of the plate on which the copy is to be made; as the *sum* of the focal distances becomes greater as the difference between the two foci increases.

To understand this arrangement for correcting the perspective, it must be borne in mind, that, in taking a photographic picture, as the end of the camera nearest any object is more elevated, the upper part of the object will be more contracted in the picture than the under part; and that, if the same end of the camera be depressed, the reverse will take place. Thus, a row of columns, instead of being perpendicular, would, in the one case, appear falling together; and, in the other, to fall outwards. As it often happens, in consequence of some obstruction, that distance enough from the object cannot be had to bring all the parts within the field, unless the camera is thus elevated or depressed, a picture in true perspective could never be made, unless the evil could be corrected in the copy, as may be done.

The operation is as follows:—Place the picture, and a plate on which the copy is to be made, in a frame, and in such manner that the parts which are perpendicular in the object shall be horizontal in the frame; then bring the end of the picture, in which the perspective is contracted, a little nearer the glasses, by causing it to turn on its axis. Then, supposing the copy to be of the size of the original, turn the end of the plate on which the copy is to be made to the same angle to the glasses as the picture is, and in such direction that the ends both of the picture and the plate for the copy which are nearest the glasses shall both be on the same side of the box. Now it will be seen, that, by this arrangement, the parts of the picture which are nearest to the glasses will be copied on to that part of the plate which is farthest from the glasses, and thereby be copied larger than if the plates were parallel; and that those parts of the picture which are farthest from the glasses will be copied on that part of the plate which is nearest to the glasses, and thus be copied smaller than if they were parallel, thus correcting the perspective in the copy. The proper angle to place the picture and plate, according to the amount of distortion, can soon be determined by a few experiments. As in the picture and plate those parts which are nearest the glasses in the one are farthest in the other, the focal distance is very nearly preserved. The sizes of the plates or pictures, with regard to the focal distance, should be such, that, when they are adjusted to the proper focal distance, either for pictures and plates of different sizes, or for those of equal size, the angles subtended from the glasses to the ends of the plate be not more than thirty degrees. For the convex lenses, common plate-glass may be used; the concave should be of the heavy flint, of a specific gravity of about 3·5; and for a focal distance of about 7·7 inches, the following proportions will perform very well. The side of the concave glass next to the aperture is plane and distant 79-100 of an inch; the other side of the concave, and also that side of the convex which is next it, are made to a radius of 1 78-100; the other side of the convex is made to a radius of 2 62-100 inches. The thickness of the concave in the middle is 6-100 inch, and that of the convex is 56-100 inch, diameters about 1¼ inch. If the pictures that are to be copied have been taken in a camera that did not contain a reflector, they would be reversed, but the copy would be correct. A metallic plate has been mentioned as the surface on which the pictures are to be copied, but any material may be used that is properly prepared to receive an impression by light. The edge of the box should be so high, that a ray of light passing into the box close to that part, and falling on to the polished surface of the picture close to its upper edge, shall, when reflected, be thrown below the glasses. It having been found that the clearest blacks in a picture are produced when the polish of the plate has been finished by straight strokes in that direction which will be horizontal in the picture, it becomes necessary,

n copying pictures formed on plates so polished, to place them in the box in such a manner that the lines of the polish shall be perpendicular; and in all cases, in whatever direction the lines of polish in the picture are, they must be placed perpendicularly in copying. In cases where the polish has been made in curved, or otherwise than in parallel straight lines, that position should be chosen in which the largest portion of the lines will be perpendicular, or most nearly so; or, at all events, in which such will be the case in the most important parts of the picture.

This position of the lines will cause the light which falls on the inclined edges of the lines (the lines of the polish being only so many minute furrows) to be reflected to that part of the box which is below the glasses; whereas, if the light was allowed to fall at right angles to the lines, a large portion of it would be reflected from the lines into the glasses. Every part of the inside of the box between the picture and the partition should be lined with black cotton velvet, or otherwise blackened, so as to prevent any injurious reflection of light. By these means, if the polished surface of the picture were viewed from the place occupied by the glasses, no object or light from objects bright enough to interfere with the operation would be perceived in it, and, of course, there would not be much light to act on the plate or other material on which the picture is to be copied, and thereby injure the copy, which it is only intended should be made by scattering lights from the rough surface produced by the adhesion of mercury, of which the picture is essentially composed, being painted on the polished background of the plate.

The plate must be first entirely divested of all traces of hyposulphite, and it is *indispensable* that it should be perfectly fixed by the chloride of gold.

In general, operators are in a hurry to see the progress of the process, which is frequently the cause of failure. They should always wait a few minutes before taking the plate out of the bath; and, each time that it is done, care must be taken not to leave it long in contact with the air, as a few minutes would suffice to oxidise the surface to such a degree as to hinder the next deposit from adhering to the first.

When the metallic coating is judged to be of sufficient thickness—and, in this case, that of a stout card suffices—the plate should be rinsed copiously in water, and then dried either with sawdust or blotting-paper. If you wish to preserve on the plate the beautiful rosy hue of the mother-of-pearl opal, which the deposit should leave on its being taken out of the bath, hasten the drying of it, after passing it once through the water, by wetting it with spirits of wine, which you also dry up with blotting-paper.

The separation of the deposit from the plate may be attended with an accident which spoils them both. It often happens that a small drop of liquid remains unperceived under the wax which covers the borders of the plate, and that, at the instant when you lift up the deposit with the blade of a knife, this drops works itself into the capillary space thus formed, and wets the deposit and the plate, which are infallibly stained if the liquid contains any remaining particles of the sulphate of copper.

The most secure process for separating the two plates consists, when the deposit is not too thick, in cutting with a pair of strong scissors all round the edges of the two plates, which then separate with the greatest facility.

The affinity of oxygen for copper being much greater than for silver, the counter-proof must be withdrawn as soon as possible from the contact of the air, by placing it in a skeleton frame; and, above all, the greatest care must be taken not to touch its surface. It is also necessary to observe the nicest precaution in preventing all dust or other foreign substances from lodging on the surface of the plate, otherwise the copy would be found disfigured with their corresponding traces.

Having thus explained the most essential conditions to be observed, we

will now enter into some further details of the operation. Lay hold of the silvered plate by one of its sides, or, if a small plate, by one of its angles, and keep that part free from oxydation, in order to attach it to the connecting wire of the trough, to which the positive pole (zinc) of the battery is joined, and the whole is held fast with a binding-screw.

The back of the plate is then covered with a coating of varnish, composed of one-third of essence of turpentine and two-thirds of beeswax, or simply of beeswax alone, in order to avoid a useless deposit of copper. Care must be taken that this coating of varnish, which should be applied hot, be of a certain thickness, and must not interpose between the plate and the connecting wire of the precipitating trough, or it would interrupt the metallic contact necessary to the success of the operation.

The sulphate of copper solution must be carefully filtered, and it must be saturated in cold water.*

When all is prepared, put the positive electrode (a copper plate which dissolves in the trough) in connexion with the negative pole of the battery (carbon), and immerse it in the bath; establish also a connexion between the proof to be reproduced and the other pole (zinc), and when firmly attached by means of one or more binding-screws, it must be immersed in the bath, when it will immediately become covered with copper.

The expense consists, therefore, only in the value of the copper deposited; and when it is considered that, with so very small an outlay, you may be able, after one or two experiments, to reproduce and multiply, without any risk of failure, the finest photographic impressions (which are always very much prized), with a very warm tone, and an admirable degree of perfection; when you reflect that the same small apparatus may serve for a number of other applications, the surprise is that it should not be more generally adopted.

ENGRAVING PHOTOGRAPHIC PLATES.

It was found that the parts over which the mercury had been deposited were deeply etched by the iodine, and a very important practical advantage has been taken of this remarkable peculiarity, by the recent attempts at etching the pictures. Professor Groves was the first to point out a mode by the aid of an acid and a powerful voltaic current, and we believe he succeeded in producing some pleasing results; but M. Fineau discovered a better mode, which is as follows:—

1. A mixed acid, composed of water, nitric acid, nitrate of potassa, and common salt, in certain proportions, being poured upon a photographic picture, attacks the pure silver, forming a chloride of that metal, and does not affect the white parts, which are produced by the mercury; but this action does not continue long. Then, by a treatment with ammonia (ammonia containing already chloride of silver in solution is preferable for this operation), the chloride of silver is dissolved and washed off, and the metal being again in its naked state, or cleansed from the chloride, it can be attacked afresh by the same acid. This acid acts better warm than cold.

2. As all metallic surfaces are soon covered, when exposed to the atmosphere, with greasy or resinous matters, it is necessary, in order that the action of the acid upon the pure silver should have its full effect, for the surface to be perfectly purified; this is effected by the employment of alcohol and caustic potash.

3. When a photographic picture is submitted to the effect of a boiling concentrated solution of caustic potash, before being attacked by the acid, the state of its surface is so modified that the acid spares or leaves, in the parts

* In order to have a solution always ready, it will be well to keep it in a large glass bottle: it will be known that it is sufficiently saturated, when, after having shaken it several times, the liquid ceases to dissolve the few crystals of sulphate of copper which remain at the bottom in excess.

which it attacks, a great number of points, which form the grain of the engraving.

4. When the effect of the acid is not sufficient, or in other words, if it has not bitten deep enough, the effect is increased by the following process:—Ink the plate as copper-plate printers do, but with a very siccative ink; when the ink is sufficiently dry, polish the white parts of the plate, and gild it by the electrotype process; then wash it with warm caustic potash, and bite in with an acid, which will not attack the gold, but only the metal in those parts which, having been protected by the ink, have not received the coating of gold. By these means the engraving is completed, as by the action of the acid alone it is not generally bitten in deep enough.

5. To protect the plate from the effects of wear, produced by the operation of printing, the following process is employed:—The surface of the plate is covered with a very thin coating of copper, by means of the electrotype process, before submitting it to the operation of printing; and when that pellicle or coating of copper begins to show signs of wear, it must be removed altogether, by plunging the plate in ammonia, or in a weak acid, which, by electro-chemical action, will dissolve the copper, without affecting the metal under it; the plate is then coppered again, by the same means, and is then ready for producing a further number of impressions. This re-coating operation may be repeated as many times as may be required. The following is the description of the whole process, which is divided into two parts, consisting of a preparatory and finishing process:—

Preparatory Engraving.—For this operation, which is the most delicate, it is necessary to have—1. A saturated solution of caustic potash. 2. Pure nitric acid at 36° of the areometer of Beaumé (spec. grav. 1·333.) 3. A solution of nitrite of potassa, composed of one hundred parts of water and five parts of nitrite, by weight. 4. A solution of common salt, composed of water one hundred parts, and salt ten parts, by weight. 5. A weak solution of ammoniacal chloride of silver, with an excess of ammonia. The ammoniacal chloride of silver must be diluted with fifteen or twenty parts of pure water. In the description of the process, this solution will be called ammoniacal chloride of silver. 6. A weak solution of ammonia, containing four or five thousandths of liquid ammonia. This solution will be called ammoniacal water. 7. A weak solution of caustic potash, containing four or five thousandths of the saturated solution, which will be called alkaline water. 8. A solution composed of water four parts, saturated solution of potash two parts, alcohol one part, all in volume. This solution will be called alcoholised potash. 9. Acidulated water, composed of water one hundred parts, and nitric acid two parts, in volume. Besides, it is necessary to have three capsulæ or dishes, made of porcelain, large enough to contain the plate, and covered with an air-tight piece of ground plate-glass, and two or three more capsulæ which do not require to be covered; two or three glass funnels, to wash the plate; and two or three glass-holders, in the shape of a spoon or shovel, by which the plate is supported when put in and taken out of the solution, without touching it with the fingers.

The daguerréotype plate is submitted to the engraving process, after having been washed in the hyposulphite of soda, and afterwards in distilled water.

First Process for Biting in or Engraving the Plate.—The following solutions must be put in the capsulæ, in sufficient quantity, so as to entirely cover the plate:—1. Acidulated water. 2. Alkaline water. 3. Alcoholised potash, in covered capsulæ. 4. Caustic potash, in covered capsulæ. 5. Distilled water.

The plate, being put upon the glass holder or spoon, is plunged in the acidulated water, and agitated during a few seconds, then put into a glass

funnel, and washed with distilled water. It is taken again with the glass spoon, and plunged in the capsula containing alcoholised potash. This capsula is covered with its glass cover, and then heated, by means of a spirit-lamp, to about 144° Fahrenheit. The plate must remain in the capsula half an hour, during which time the solution is heated now and then, and agitated. During that time the following acid solution, which will be called *normal acid*, must be prepared; it is composed as follows:—Water six hundred parts, nitric acid forty-five parts, solution of nitrite of potassa twelve parts, solution of common salt forty-five parts. These proportions are in volume. The normal acid must be poured in a capsula, covered with its glass cover, and a sufficient quantity must be kept in the bottle.

When the plate has been immersed in the alcoholised potash during half an hour, it is taken out of the solution by means of the glass holder, and immediately plunged in the alkaline water, and agitated pretty strongly; from thence it is put in distilled water (A).

This being done, the plate is plunged in the acidulated water, and moved about therein for a few seconds: it is then put into the normal acid. When the plate has been immersed a few seconds in the acid, it is taken out by means of the glass holder, taking care to keep it as much as possible covered with the solution, and it is immediately placed horizontally upon a stand, and as much acid as the plate can hold is poured upon it from the bottle; it is then heated with a spirit-lamp, but without attaining the boiling point. During this operation, it is better to stir or move about the acid on the plate by pumping it, and ejecting it again, by means of a pipette or glass syringe; after two or three minutes the acid is thrown away, the plate is put in the glass funnel, and there washed with water, and afterwards with distilled water (B).

Then, without letting the plate dry, it is put upon the fingers of the left hand, and with the right hand some ammoniacal chloride of silver, which is moved about the surface by balancing the hand, is poured upon it; the solution is renewed until the chloride, formed by the action of the acid, is dissolved: the plate is then washed by pouring upon it a large quantity of ammoniacal water, and afterwards some distilled water (C).

Without allowing the plate to dry, it is then put in the caustic potash, and the capsula being placed upon the stand, the potash is heated up to the boiling point; it is then left to cool (D); and beginning again the operations described from A to D, the second biting is obtained; and by repeating again the operations described in A and B, a third biting is produced. The plate is then dried; in this state the black parts of the plate are filled with chloride of silver.

The plate is then polished until the white parts are perfectly pure and bright. This polishing is done with cotton and "pounce" (pumice-stone); afterwards, the chloride of silver, filling the black parts, is cleansed by the means described in B and C. The plate is then dried; but, before drying, it is well to rub the plate slightly with the finger, in order to take off from the black parts any remains of an insoluble body which generally remain on it. The preparatory engraving is then finished, and the place has the appearance of a very delicate aquatint engraved plate, not very deeply bitten in.

Nevertheless, if the operation has been well managed, and has been successful, it is deep enough to allow the printing of a considerable number of copies.*

* Sometimes, instead of treating the plate with the boiling potash in the capsula, similar result may be obtained by placing the plate upon the stand, covering it with the solution, and heating it by means of a spirit-lamp, until, by evaporation, the potash becomes in a state of ignited fusion. By this means the grain is finer, but the white parts are more liable to be attacked.

Last Operation of Biting in.—This operation requires some of the reagents before named, and also,

1. A siccative ink, made of linseed oil, rendered very siccative by boiling it sufficiently with litharge; it may be thickened with calcined lamp-black.

2. An electrotype apparatus, and some solutions fit to gild and copper the plate.

Means of Operating.—The plate must be inked as copper-plate printers do, taking care to clean off the white parts more perfectly than usual; the plate is then to be placed in a room sufficiently warm, until the ink is well dried, which requires more or less time, according to the nature of the oil employed. The drying of the oil may be hastened by heating the plate upon the stand with the lamp, but the slow process is more perfect and certain.

When the ink is well dried, the white parts are cleaned again by polishing the plate with cotton and pounce, or any other polishing powder. a ball of cotton, or any other matter, covered with a thin piece of caoutchouc or skin, can be used for this purpose. When polished, the plate is ready to receive the electro-chemical coating of gold, which will protect the white parts.

Gilding.—The gilding is obtained by any of the various processes of electrotyping which are known. The only indispensable condition is, that the surface obtained by the precipitation must not be liable to be attacked by any weak acid; a solution answering this purpose is made of ten parts (by weight) of ferrocyanide of potassium, one part of chloride of gold, and 1000 parts of water, used with a galvanic battery. During the gilding the plate must be turned in several positions, in order to regulate the metallic deposit. In some cases the gilding may be made more perfect if the plate is covered with a thin coating of mercury before being put in the gilding solution.

When the plate is gilded, it must be treated with the boiling caustic potash, by the process already indicated for the preparatory engraving, in order to cleanse it from all the dried oil or ink which fits the hollows. The plate is then washed and dried; and when the oil employed has been thickened with the lamp-black, the surface of the plate is rubbed with crumb of bread, in order to cleanse and take off the black remaining; then, the white parts being covered and protected by a varnish not liable to be attacked, and the black parts being uncovered and clean, the plate can be bitten in by aquafortis, according to the ordinary process used by engravers.

This operation must be done upon the stand, and not by immersing the plate in the solution.

Before this last biting-in, if the preparatory engraving has not succeeded well, and the plate still wants a sufficient grain, it can be given by the various processes of aquatint engraving.

Before submitting the plate to the operation of printing, in order to ensure an unlimited number of copies, it is necessary, as before stated, to protect it by a slight coating of copper, which is obtained by the electrotype process; otherwise the printing would soon wear the plate. This coating must be kept very thin, lest the fineness of the engraving, and the polish of the white parts, should be destroyed. In this state the plate can be delivered to the printer.

After a certain number of impressions have been obtained, it will be perceived that the coating of copper is worn in some places; then this coating must be removed, and a fresh one applied in its place. For this purpose, the plate must be purified and cleansed by warm potash and plunged in a weak acid, composed as follows:—Water 600 parts, nitric acid 50 parts, nitrous acid of engravers 5 parts, all in volume. This acid will dissolve the coating of copper; and the plate being coppered again by the same means as before, may be again submitted to the operation of printing; and, as nothing can prevent the success of a repetition of the same operation, any number of

mpressions may be obtained. The coating of copper can also be removed by caustic ammonia.

The daguerréotype plates engraved by this process, which constitute the present invention, consist—

First, in the discovery and employment of certain properties of a mixture composed of nitric acid, nitrous acid, and hydrochloric acid, in determined or fixed proportions. The two last-mentioned acids may be employed either in a free state, or combined with alkaline or other bases. This mixed acid has the property of biting the pure silver which forms the black parts of the daguerréotype picture, without attacking the white parts formed by the amalgam of mercury. The result of the action of the biting is to form on the black parts of the picture an insoluble chloride of silver; and this chloride of silver, which, when formed, stops the action of the acid, is dissolved by the ammonia, which allows the biting to continue.

Secondly, in the discovery of certain properties of a warm solution of caustic potash, and in the employment of the said solution, by which the mercury forming the picture is better and deeper amalgamated with the silver under it, so that many imperceptible points of the amalgam are affected in such a manner that the acid has no action upon them.

Thirdly, in the discovery and employment of a process which produces a grain favourable to the engraving, by which the biting on the plate is rendered deeper. This is effected by filling the parts engraved with a siccative ink, or any other substance, and then gilding the plate by the electrotype process; the gold is not deposited on the parts protected by the ink. When the plate is gilded, the ink is cleansed by the caustic potash, and the plate may be submitted to the effects of an acid which does not attack the coating of gold but bites only on the silver in the parts already engraved by the first operation.

Fourthly, in the employment of a process by which the plate is protected from the wear of the printing operation. This is effected by covering the plate before printing with a slight coating of copper by the electrotype process; and, when the coating begins to wear by printing, it is removed by a weak acid, or by ammonia, which dissolves the copper without affecting the silver under it. The plate is coppered again, and after another printing the same operation is repeated, so that a considerable number of copies may be printed without much injury to the engraving.

We have seen pictures printed on paper from these etched plates, and they approach a very fine mezzo-tinto.

Claudet has fully established the successful application of this process to the purposes of illustrating natural history, by copying from nature, and engraving several delicate and difficult dissections of the lower animals, particularly the nervous system of *Aplysia* and *Tritonia* (the latter much magnified), and the nutrimental organs *in situ* of a caterpillar, some of which may be seen in the Hunterian Museum of the Royal College of Surgeons, with the animals they were copied from.

Captain Ibbetson also employed a similar process for engraving microscopic objects. He exhibited some plates of blood-globules, &c., procured in this way by Dr. Donné, of Paris. It must be observed, to produce a very perfect specimen, that it generally requires to be finished by the hand of the engraver, who has the advantage of a *perfect*, although *faint* picture to work upon.

The following is M. Poitevin's new process, by the aid of which daguerréotype images, designs, or engravings may be readily transferred to photographic paper:—"The image is received in the camera obscura on a plate of silver, strongly iodised; the plate is then exposed to the vapour of mercury, but not to the action of hyposulphite of soda. It is then plunged into a solution of sulphate of copper, placing it for a few instants in communication with the negative pole of a battery, and closing the circuit with a platina wire. The copper

deposits itself only on the parts covered by the mercury, the iodide of silver not being a conductor of electricity. The plate is first washed with distilled water, then with the hyposulphate of soda to remove the iodide, and quickly dried over a spirit lamp. The image, in which the copper represents the light parts and the silver the dark, is transferred, at least the copper, on very thin plates of gelatine. An inverted image is thus obtained, since the copper, which is opaque, represents the light parts. The transfer is made by running on the plate a clear solution of gelatine, and allowing it to dry; after which the gelatinous foil, on which the copper adheres, is detached. The negative proof obtained, the next part of the process is, to re-produce a positive image. For this purpose, a sheet of photographic paper is taken, on which is carefully applied the proof in gelatine, the face on which is the copper underneath. The whole is then exposed to diffused light during a quarter of an hour; the paper is then plunged into water in order to be washed, and then into a solution of hyposulphite of soda to remove the salt of silver; it is then washed in a large quantity of water, and dried. By this means, a perfect and positive re-production of a daguerréotype image is obtained.

"If it be desired to obtain the re-production of a drawing or an engraving, a negative proof is taken on a prepared iodised plate, in placing it over the design or engraving, and exposing the whole to the light. It is then passed through the mercurial process, and the series of operations above described."

IMPROVED CAMERAS.

The investigations of scientific men are constantly adding new facts and improvements to this most interesting and beautiful process. The ingenious invention of M. Martens, which he has denominated the "*panoramic*," or "revolving camera," may be briefly explained; as by this instrument he has been enabled to photograph an entire panorama, embracing 150 degrees. To effect this he used a plate of about twelve inches long, or a succession of plates, slightly curved; the lens is so adapted to the front of the camera, that by a simple cog-wheel, he is enabled to give it a horizontal movement, whereby the images are refracted continuously upon the prepared plate.

The advantages resulting from this arrangement are, that with an object-glass of inferior capacity a picture may be obtained of considerable longitudinal extent, and that the operation of the solar influence may be arrested or prolonged at the discretion of the artist. It thus becomes possible to apply an equal amount of chemical action to every object which in turn is brought within focus, notwithstanding that some objects may be at greater distance, or of less dimensions, or less illuminated than others, by altering the focus proportionately, or by continuing the action, or by both these means. Hereby, a number of inanimate objects, or, in portraiture, a group of many persons, extending over a space which it would be difficult to include at one focus with a camera of the largest size, may be comprehended in the same picture.

The application of the microscope in photography is obviously important, and will be understood by supposing the instrument so arranged as that the sensitive tablet may be made to occupy precisely the same place as the eye when obtaining the focus. Thus, in a few seconds the image of the magnified atom is impressed, again to meet the sight, as once before it did, but not now, as a vision, to pass away.

Another important suggestion for the improvement of the camera is that announced by Sir David Brewster, and which he has called a "Binocular Camera," although we must inform our readers that the principal object Sir David had in view was, a means of obtaining copies of statues and living bodies which can be exhibited as solids by the *Stereoscope* of Professor Wheatstone. Nevertheless, as it is intended principally for photographists, and may be of some used in aiding the better representation of all such productions, we shall give his explanation in detail. Sir D. Brewster says :—

"In order to understand the subject we shall first consider the vision with *one eye* of objects of three dimensions, when of different magnitudes, and placed at different distances. When we thus view a building or a full length or colossal statue, at a short distance, a picture of all its visible parts is formed on the retina. If we view it at a greater distance, certain parts cease to be seen, and other parts come into view; and this change on the picture will go on, but will become less and less perceptible, as we retire from the original. If we now look at the building or statue from a distance through a telescope, so as to present it to us with the same distinctness, and of the same apparent magnitude, as we saw it at our first position, the two pictures will be essentially different; all the parts which ceased to be visible as we retired, will still be invisible, and all the parts which were not seen at our first position, but became visible by retiring, will be seen in the telescopic picture. Hence, the parts seen by the near eye, and not by the distant telescope, will be those towards the middle of the building or statue, whose surfaces converge, as it were, towards the eye, while those seen by the telescope, and not by the eye, will be the external parts of the object, whose surfaces converge less, or approach to parallelism. It will depend on the nature of the building or the statue, which of these pictures gives us the most favourable representation.

"If we now suppose the building or statue to be reduced in the most perfect manner—to half its size, for example—then it is obvious that these two perfectly similar solids will afford a different picture, whether viewed by the eye or by the telescope. In the reduced copy, the inner surfaces visible in the original will disappear, and the outer surfaces become visible; and, as formerly, it will depend on the nature of the building or the statue, whether the reduced or the original copy gives the best picture.

"If we repeat the preceding experiments with *two eyes* in place of *one*, the building or statue will have a different appearance. Surfaces and parts, formerly invisible, will become visible, and the body will be better seen because we see more of it; but then, the parts thus brought into view, being seen, generally speaking, with one eye, will have only one-half the illumination of the rest of the picture. But though we see more of the body in binocular vision, it is only parts of vertical surfaces perpendicular to the line joining the eyes that are thus brought into view, the parts of similar horizontal surfaces remaining invisible as with one eye. It would require a pair of eyes placed vertically, that is, with the line joining them in a vertical direction, to enable us to see the horizontal as well as the vertical surfaces, and it would require a pair of eyes inclined at all possible angles, that is, a ring of eyes 2½ inches in diameter, to enable us to have a perfectly symmetrical view of the statue.

"With these observations, we shall be able to determine the best method of obtaining dissimilar plane drawings of full-length and colossal statues, &c., in order to reproduce them in three dimensions by means of the stereoscope. Were a painter called upon to take drawings of a statue, as seen by each eye, he would fix, at the height of his eyes, a metallic plate with two small holes in it, whose distance is equal to that of his eyes, and he would then draw the statue as seen through the holes by each eye. These pictures, however, whatever be his skill, would not be such as to reproduce the statue by their union. An accuracy, almost mathematical, is necessary for this purpose, and this can only be obtained from pictures executed by the processes of the Daguerreotype and Talbotype. In order to do this with the requisite nicety, we must construct a binocular camera which will take the pictures simultaneously, and of the same size; that is, a camera with two lenses of the same aperture and focal length, placed at the same distance as the two eyes. As it is impossible to grind and polish two lenses, whether single or achromatic, of exactly the same focal lengths, even if we had the very same glass for each, I propose to bisect the lenses, and construct the instrument

with semi lenses, which will give us pictures of precisely the same size and definition. These lenses should be placed with their diameters of bisection parallel to one another, and at the distance of $2\frac{1}{2}$ inches, which is the average distance of the eyes in man; and, when fixed in a box of sufficient size, will form a binocular camera, which will give us, at the same instant, with the same lights and shadows, and of the same size, such dissimilar pictures of statues, buildings, landscapes, and living objects, as will reproduce them in relief in the stereoscope.

"It is obvious, however, from observations previously made, that even this camera will only be applicable to statues of small dimensions, which have a high enough relief, from the eyes seeing, as it were, well around them, to give sufficiently dissimilar pictures for the stereoscope. As we cannot increase the distance between our eyes, and thus obtain a higher degree of relief for bodies of large dimensions, how are we to proceed in order to obtain drawings of such bodies of the requisite relief?

"Let us suppose the statue to be colossal, and *ten* feet wide, and that dissimilar drawings of it about *three* inches high are required for the stereoscope. These drawings are *forty* times narrower than the statue, and must be taken at such a distance, that, with a binocular camera having its semilenses $2\frac{1}{2}$ inches distant, the relief would be almost evanescent. We must, therefore, suppose the statue to be reduced n times, and place the semilenses of the binocular camera at the distance n multiplied by $2\frac{1}{2}$ inches. If $n = 10$, the statue will be reduced to $\frac{10}{10}$, or to 1 foot, and n multiplied by $2\frac{1}{2}$, or the distance of the semilenses, will be 25 inches. If the semilenses are placed at this distance, and dissimilar pictures of the colossal statue taken, they will reproduce by their union a statue *one* foot high, which will have exactly the same appearance and relief as if we had viewed the colossal statue with eyes 25 inches distant. But the reproduced statue will have also the same appearance and relief as a statue a foot high, reduced from the colossal one with mathematical precision, and therefore it will be a better and a more relieved representation of the work of art than if we had viewed the colossal original with our own eyes, either under a greater, an equal, or a less angle of apparent magnitude.

"We have supposed that a statue *a foot broad* will be seen in proper relief by binocular vision; but it remains to be decided whether or not it would be more advantageously seen, if reduced with mathematical precision to a breadth of $2\frac{1}{2}$ inches, the width of the eyes, which gives the vision of a hemisphere $2\frac{1}{2}$ inches in diameter, with the most perfect relief.

"In the same manner we may obtain dissimilar pictures of living bodies, buildings, natural scenery, machines, and objects of all kinds, of three dimentions, and reproduce them by the stereoscope, so as to give the most accurate idea of them to those who could not understand them in drawings of the greatest accuracy.

"The art which we have now described cannot fail to be regarded as of inestimable value to the sculptor, the painter, and the mechanist, whatever be the nature of his production in three dimensions. Lay figures will no longer mock the eye of the painter. He may delineate at leisure on his canvas the forms of nature and beauty, stereotyped by the solar ray and reconverted into the substantial objects from which they were obtained, brilliant with the same lights, and chastened with the same shadows as the originals. The sculptor will work with similar advantages. Superficial forms will stand before him in three dimensions, and while he summons into view the living realities from which they were taken, he may avail himself of the labours of all his predecessors, of Pericles as well as of Canova; and he may virtually carry in his portfolio the mighty lions and bulls of Nineveh—the gigantic sphinxes of Egypt—the Apollos and Venuses of Grecian art—and all the statuary and sculpture which adorn the galleries and museums of civilized nations."

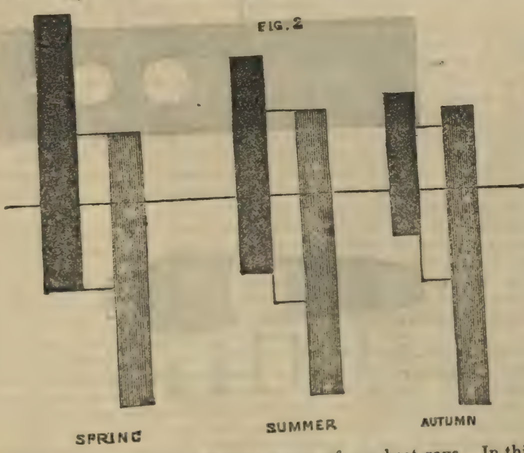
SOLAR INFLUENCES.

PHOTOGRAPHY has further established that there exists latent light, or the influence and principle of light, in darkness; and it has been proposed to produce photographic pictures in absolute darkness, in the following manner:—

A large prismatic spectrum is thrown upon a lens fitted into one side of a dark chamber; and, as we know that the actinic power resides in great activity beyond the violet ray, where there is no light, the only rays which we allow to pass the lens into the chamber are those which are extra-spectral and non-luminous. These are directed upon any object, and from that object radiated upon a highly sensitive plate in a camera obscura. Thus a copy of the subject will be obtained by the agency of radiations which produce no sensible effect upon the optic nerve. This experiment is the converse of those which show us that we may illuminate any object with the strongest sunlight which has passed adeo-actinic media, as yellow glass, the yellow solution of sulphate of lime, or of the bichromate of potass, and yet fail to secure any daguerréotype copy of it, even upon the most exquisitely sensitive plate. In deed, the image of the sun itself, when setting through an atmosphere which imparts to its disc a red or rich yellow colour, not only produces no chemical change, but protects the tablet from it; and, whilst every other part of an iodized plate gives a picture of surrounding objects in the ordinary character, the bright sun itself is represented by a spot, upon which no change has taken place.

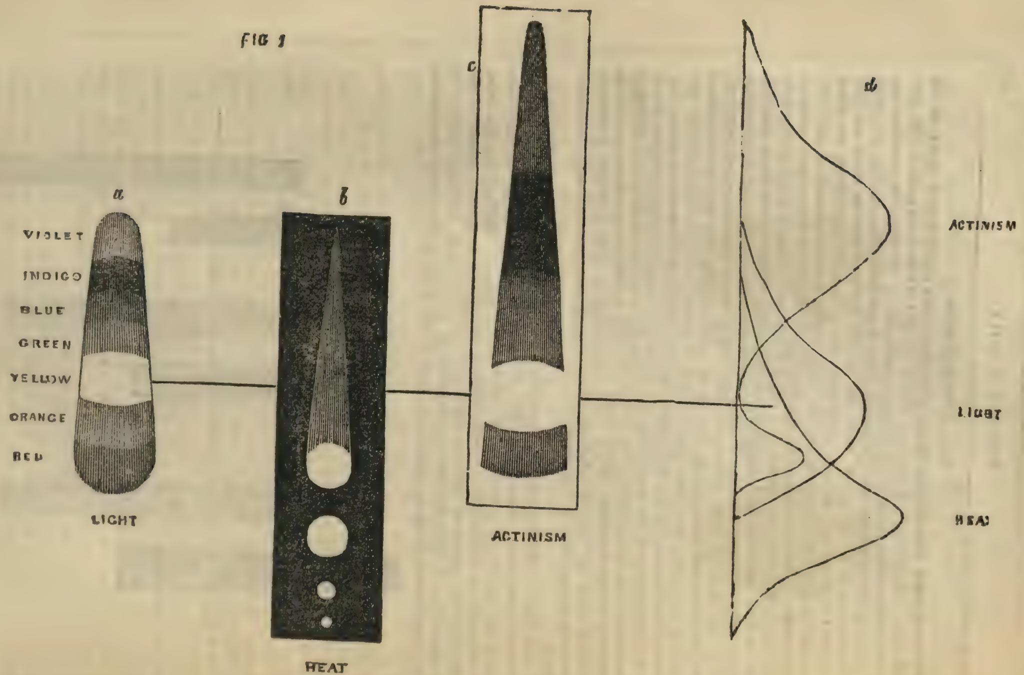
Mr. Hunt, who has devoted so much time to the investigation of the influence of the solar rays, says:—We have been hitherto led to regard the sun's rays as consisting essentially of light and heat: and these, indeed, were commonly considered as modifications of one power. Melloni has, however, shewn that plates of obsidian and black mica which do not admit of the permeation of light, are freely penetrated by heat; and, on the contrary, that a glass stained green by oxide of copper, which offers scarcely any obstruction

FIG. 2



to light, will scarcely allow of the passage of any heat-rays. In this way it is distinctly shewn that the physical conditions of these forces are essentially

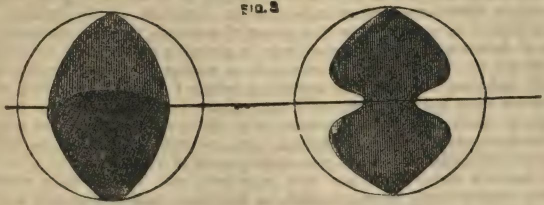
FIG 1



MR. HUNT'S DIAGRAM OF HEAT AND ACTINISM.

different; and, in a similar manner, we may entirely obstruct the chemical agency by the use of a yellow glass, while a blue medium, which obstructs nearly all the light, admits of the free passage of the chemical radiations.

FIG. 3



LIGHT & HEAT ACTINISM

In this manner we are made acquainted with the existence of, certainly, three physical agents in the solar beams—light, heat, and actinism, as the chemical power is called. Their existence may be shown in the following manner:—If we pass a sunbeam through a glass prism, we get a coloured luminous image (*a, fig.* 1) consisting of seven chromatic bands. If we throw the same image upon black paper washed with ether, an image rapidly dries in the forms shown in *b*, which represents the heat's rays, and proves the existence of calorific rays, which are entirely without light; and if we throw the same image on paper covered with the chloride of silver, it is blackened in the manner shewn at *c.* in which the most decided chemical change is observed to take place beyond the violet ray, where there is no light; and that in the yellow ray, where the light is at its greatest intensity, no chemical change is produced. The curved lines (*d*) shew the relative points of maximum influence in the solar spectrum for each power.

From all the phenomena which these solar powers exhibit, it is evident that they exist in a state of antagonism, and one is sometimes in a state of superior activity compared with another. Seeds require an excess of actinism to germinate; and they will not germinate in light from which the actinic power is separated. After the leaves are formed, a larger amount of light than of actinism is necessary to produce that excitation of the cellular system of the plant by which carbon is separated from carbonic acid, and wood produced. Again, the full developement of the reproductive system of the plant, its flowering and fruiting, depends upon an influence which is more closely connected with the thermic power of the sun's rays, than on either light or actinism. A very curious series of experiments have been made to prove that seeds will not germinate in pure light. Plants will not form wood in unmixed actinic radiations, nor will they flower in either light or actinism separated from the heat-rays. It has also been found that the relative proportions of light, heat, and actinism vary in the seasons of spring, summer, and autumn in the manner shewn in *fig.* 2, which is in exact accordance with the results obtained by experiment—the black band representing Actinism, the white one Light, and the shaded one Heat.

Thus so beautifully has nature disposed of the constitution of the solar beams, that these antagonistic powers are balanced one against the other in exact accordance with the requirements of organic nature. It has been discovered that the proportions of these principles are different in various parts of the globe; light and heat being at a maximum at the equator, and diminishing towards the poles; whereas, actinism is at its minimum at the equator, and arrives at its maximum in the temperate zones. This fact ex-

plains the cause obviously of the gigantic vegetation of the tropics, and the gradual dwarfing of plants as we proceed towards the pole. The conditions are represented in *fig.* 3.

Indeed, it may be proved by simple experiments that the sun's rays cannot fall upon any body, whether it be of metal, of wood, of stone, or of glass, without producing a disturbance, either molecular or chemical, on its surface; also that all bodies in nature have the power of restoring themselves during the hours of darkness to the state they were in previous to the solar disturbance. May we not hence infer, that darkness is as necessary to the inorganic body, as night and sleep to living and breathing beings? These researches, which have arisen from the discovery of Photography, have already led to the elucidation of many mysteries connected with the great phenomena of nature; and the discovery of the new element *actinism* promises to lead us rapidly forward in our examinations of the secret powers of creation.

M. Claudet's experiments are very ingenious, and deserve to be repeated by every experimental photographist, as they may tend to elucidate some of the more important actinic influences.

In the following description, it may be understood that when the term "*red*" light is used, "*orange*" or "*yellow*" would apply with the same propriety. Also, that the words "sensitive" and "sensitiveness" are employed in their simple acceptation—as meaning sensitive to ordinary light in the primary condition of the prepared daguerréotype plate.

1. An iodized tablet, which has been exposed in the camera for twenty minutes when the disc of the sun (obscured by fog) appeared red, the image of the sun being in the focus, exhibits a broad black line, extending so far as the figure of the sun passed over it by the earth's rotation; the other part of the plate is distinguished by the adhesion of the mercurial vapour.

2. An iodized tablet, after being subjected to the action of white light (the predominance of the blue and violet rays)—hence no longer "sensitive"—had been covered with a piece of black lace, and exposed to red light by radiation through red glass: it exhibits a *negative* picture—white lace on a black ground.

3. An iodized tablet, which had been first exposed to diffuse *white* light, then to *red* light, by radiation through red glass, and, lastly, to *white* light again, under black lace as before: displays a *positive* picture—black lace on a white ground.

The first example shows that the photogenic effect which the action of light had produced prior to the passage of the sun (proved by the presence of the mercury), was subsequently destroyed by the direct ray reflected from the image of the red disc. By the second example, we concurrently learn that after the action of ordinary light had brought the sensitive tablet into a condition for attracting the mercurial molecules, the action of red light annulled the antecedent effect of white light, and reinstated it sensitive to white light as at first; for those parts not protected from the influence of red light by the intersection of the black lace, were found at the completion of the process exempt from the mercury, as if white light had never beamed upon them. By the third example we are taught the same, yet more plainly and conclusively, insomuch that the "sensitiveness" having been destroyed by the action of white light, the result proves that the tablet was restored by red light to its original capability of yielding the positive image to white light: for in this instance only those portions of the tablet which were finally unprotected by the intersection of the lace, have received the mercurial vapour, although the whole surface of the tablet had been primarily exposed to the action of white light.

The two contrary actions indicated by these experiments may be alternated and repeated continually, without ultimate disadvantage to the sensitive property of the superfice. This discovery is photographically valuable, by bestowing the means whereby to re-establish at any time the sensitive property

of a tablet accidentally exposed to light, and of preparing the plates in daylight when a dark room is not available—namely, by submitting them to the radiation of red, orange, or yellow glass, immediately before placing them in the camera.

Another interesting consequence of M. Claudet's experiments is, that, although the red, orange, and yellow rays have respectively the property of counteracting the influence of white light (or, more properly, of the blue and violet rays to which is due the photogenic power of white light), they, in turn, have also an antagonistic action of their own. The red ray invalidates the effect of the yellow ray, and the yellow that of the red, in the same manner, as has been shown above, as the blue ray annuls the effect of the red and yellow. The photogenic action begun by a particular ray will not be continued by another ray, neither the destructive action of one by another. They are all antagonistic, nor assist each other for the photogenic or for the destructive action.

By acquiring knowledge of these seemingly conflicting constituents in light, we are enabled to account for the vexatious and before-mysterious difficulties in obtaining photographic results. With, apparently, the same light and atmosphere, operators encounter all degrees of variation in effect. During the same morning, an equivalent effect to that obtained *now* in thirty seconds, shall, in the course of half an hour or less, require three, four, or five minutes. *To-day*, with full light, a good photograph will be unattainable; whilst *to-morrow*, with a comparatively dull light, the operation shall be perfect and expeditious. Nor can we fail to observe the significance of these facts in connexion with what we are accustomed to denominate "the influence of the atmosphere" upon the human frame. The principle of light prevades the atmosphere, and is doubtless among the subtle agencies imperceptibly affecting us.

THE CALOTYPE, OR TALBOTYPE.

The art of Photography is greatly indebted to Mr. Fox Talbot for its present state of perfection. Mr. Talbot was the first who succeeded in *fixing* images taken by the camera, and by super-position on paper; and he has steadily pursued his experiments until the perfection of the calotype has rewarded his perseverance. Some of his recently published productions are, for minuteness of detail and beauty, very little inferior to those taken on silver plates. Several other inquirers have been labouring in the same field, and the result of their researches has been the extraordinary discovery, that all bodies are constantly undergoing changes under the influence of the solar rays; from the delicately sensitive film which is formed on the silver plate to all the salts of the metals, and even to the metals themselves, or plates of glass or stone, all have been found capable of receiving light impressed pictures. A shadow cannot fall upon any solid body without leaving evidence behind it, in the disturbed and undisturbed condition of its molecular arrangement of the parts in light or shade. It is evident, then, that all bodies are capable of photographic disturbance, and might be used for the production of pictures, did we but know the methods by which the pictures might be developed, for it must be remembered that in all the best photographic processes the images are invisible at first, and we are not without hope that at no very distant time these means may be discovered.

It may be said, that in no age of the world has a philosophic invention so intimately subserved to intellectual refinement, and laid its claim upon the affections, as Photography—enough to engage us if alone we were enabled to seize the reflected image of inanimate objects, rendered interesting by domestic or historic association, or by the demands of knowledge. But when we consider that Photography enables us to preserve from the decay of time and the fickle tenure of mortality, the true type of the features of those we love, our admiration and gratitude can scarcely be excessive. True, we

could before have a picture, and when the moment of recognition had passed away, or when the original had never met our sight, we fondly deceived ourselves into the belief that it was a faithful representative, or at least a resemblance; but what doubts must disturb our faith! deficient skill, only partial success, flattery, or whimsicality of the artist. If we would retain in love or esteem the corporeal presence, we do not want a picture, but a portrait. How rich a satisfaction were it to us did we possess the reflected image of our Shakespeare's face, instead of the surreptitious lineaments of an imaginary effigy!

With regard to the instrument that produces these wonderful results, the eye, in its more superficial, mechanical arrangement, presents exactly the same character as a camera obscura, the cornea being the lens which receives the images of objects and refracts them; but how infinitely more beautiful are all the arrangements of the organ of vision than the dark chamber of Baptista Porta. Arranged within this globe, we have the aqueous humour, crystalline lens, and the vitreous humour; the first is a watery fluid, and the last a gelatinous one, while the crystalline lens is a little capsule of fluid membranaceous matter. These are for the purpose of correcting any aberrations of light which are so evident in ordinary lenses, and giving to the whole an achromatic character, in which so perfect is everything in form and arrangement that both spherical and chromatic aberration are corrected, and, by the agency of the cornea, and the crystalline lens, perfect images are depicted on the retina, in a similar way to those very charming pictures which present themselves on the table of the camera obscura.

There is likewise a mysterious, or, at least, interesting resemblance between the operation of Photography and the faculty of memory, as connected with that of vision, whence, in a manner to us incomprehensible, the figures are communicated to the brain. There, amidst its wonderful convolutions, are the images imprinted and retained with greater or less degree of precision and intensity, conformable with the condition and quality of the recipient. Yet, how know we the numerical extent of those immaterial existences lying concealed—like the latent pictures of Herschel when visually annihilated by corrosive sublimate—we suppose we have forgotten, until some circumstance involuntarily recals the impression or reproduces the visual image of twenty, or thirty, or forty years ago. What a suggestion does this convey of the eternal permanency of our thoughts and actions!

When we examine into the photographic process, originated by Mr. Fox Talbot, we shall have the satisfaction of finding that, whether as regards its merits as a philosophic discovery or the beauty and advantages of its results, our countryman may vie for honour with his ingenious French contemporary. If on the side of Photography claim be made for superior sharpness of definition and perfection of detail, it may be retorted in praise of Mr. Talbot's picture that it has more the pictorial effect, in its gradation of shade, of a work of art. Whilst we admit the exquisite sharpness and surpassing beauty of finish of the photograph we cannot forget the expense and difficulty necessary to the acquisition of it, nor the inconvenience attendant upon its preservation. Moreover, the Talbot picture being formed by a negative image may be made to repeat itself by contact illimitably. Thus a single original will yield any number of copies, like an engraved steel or copperplate; and thus books upon natural history, botany, or archæology may be illustrated by drawings which we know to be exact and truthful representations, free, indeed from the possibility of error. This process was named by Mr. Talbot, Calotype, from καλός, "beautiful." So highly sensitive to light is the calotype paper, that "enlarged copies of Daguerréotype and Talbotype portraits can be obtained by throwing magnified images of them, by means of lenses, upon it. Letterpress may also be photographically copied with

calotype paper. Blocks of wood may be endued with the sensitive property, so as to receive the positive image from a negative type on paper, of a drawing or natural object, and in this state is admirably prepared for engraving.

The Catolypic department of Photography, which includes the acquisition of (negative) drawings on paper by contact, is highly important, because the most generally available for the purposes of every-day life, in travelling or at home.

Although every particular of the calotype process has its true philosophic bearing upon the ultimate effect, the discovery of the photographic value of gallic acid in combination with nitrate of silver and other substances, is the feature most novel to chemists.

We have th n to determine the best method of preparing photographic paper with regard to clearness of definition of the negative image, correctness of the counterpart, the quality of preserving in a folio without change, and the capability of effectual fixing; the process is then conducted with the utmost facility.

We shall therefore proceed to give, in Mr. Talbot's own words, the very latest improvements he has published for the preparation of the calotype paper. The only apparatus necessary for this purpose are a few wood frames, a trifle smaller than the sheets of paper to be prepared, two or three soft camel's hair brushes, some sheets of white blotting-paper, two or three glasses for holding the solutions, and two glass stirring rods.

"*First Part of the Preparation of the Paper.*—I dissolve 100 grains of chrystallised nitrate of silver in six ounces of distilled water; I wash one side of the paper with this solution with a soft camel hair brush, and place a mark upon that side by which to know it again. I dry the paper cautiously at a distant fire, or else I leave it to dry spontaneously in a dark place. Next I dip the paper in a solution of iodide of potassium, containing 500 grains of that salt dissolved in one pint of water. I leave the paper a minute or two in this solution. I then take it out and dip it in water. I then dry it lightly with blotting-paper, and finish drying it at a fire, or else I leave it to dry spontaneously. All this process is best done in the evening, by candle-light. The paper thus far prepared may be called, for the sake of distinction, iodised paper. This iodised paper is scarcely sensitive to light, but nevertheless it should be kept in a portfolio or some dark place till wanted for use. It does not spoil by keeping any length of time, provided it is kept in a portfolio and not exposed to the light.

"*Second Part of the Preparation of the Paper.*—This second part is best deferred until the paper is wanted for use. When that time is arrived I take a sheet of the iodised paper and wash it with a liquid prepared in the following manner. Dissolve 100 grains of chrystallized nitrate of silver in two ounces of distilled water; to this solution add one-sixth of its volume of strong acetic acid; let this mixture be called A; dissolve chrystallized gallic acid in distilled water, as much as it will dissolve (which is a very small quantity); let this solution be called B. When you wish to prepare a sheet of paper for use, mix together the liquids A and B, in equal volumes. This mixture I shall call by the name of gallo-nitrate of silver Let no more be mixed than is intended to be used at one time, because the mixture will not keep good for a long period. Then take a sheet of iodized paper and wash it over with this gallo-nitrate of silver with a soft camel hair brush, taking care to wash it on the side which has been previously marked. This operation should be performed by candle-light. Let the paper rest half a minute, and then dip it into water, then dry it lightly with blotting-paper; and, lastly, dry it cautiously at a fire, holding it at a considerable distance therefrom. When dry, the paper is fit for use; but it is advisable to use it within a few hours after its preparation.

"Note, that if it is so used immediately, the last drying may be dispensed with, and the paper may be used moist.

"Note 2. Instead of using a solution of gallic acid for the liquid B, the tincture of galls diluted with water may be used, but it is not so advisable.

"*Use of the Paper.*—The paper thus prepared, and which I name calotype paper, is placed in a camera obscura, so as to receive the image formed in the focus of the lens. Of course the paper must be screened or defended from the light during the time it is being put into the camera. When the camera is properly pointed at the object, this screen is withdrawn, or a pair of internal folding-doors are opened, so as to expose the paper for the reception of the image. If the object is very bright, or the time employed is sufficiently long, a sensible image is perceived upon the paper when it is withdrawn from the camera; but when the time is short, or the objects dim, no image whatever is visible upon the paper, which appears entirely blank. Nevertheless it is impressed with an invisible image, and I have discovered the means of causing this image to become visible. This is performed as follows:—I take some gallo-nitrate of silver, prepared in the manner before directed, and with this liquid I wash the paper all over with a soft camel hair brush. I then hold it before a gentle fire, and in a short time (varying from a few seconds to a minute or two) the image begins to appear upon the paper. Those parts of the paper upon which light has acted the most strongly become brown or black, while those parts on which the light has not acted remain white. The image continues to strengthen and grow more and more visible during some time; when it appears strong enough the operation should be termiuated and the picture fixed.

"*The Fixing Process.*—In order to fix the picture thus obtained, I first dip it into water. I then partly dry it with blotting-paper, and then wash it with a solution of bromide of potassium, containing 100 grains of the salt dissolved in eight or ten ounces of water. The picture is then washed with water, and then finally dried. Instead of bromide of potassium, a strong solution of common salt may be used, but it is less advisable. The picture thus obtained will have its lights and shades reversed with respect to the natural objects; viz. the lights of the objects are represented by shades, and *vice versâ*. But it is easy from this picture to obtain another, which shall be conformable to nature, viz. in which the lights shall be represented by lights, and the shades by shades. It is only necessary for the purpose to take a second sheet of sensitive calotype paper and place it in close contact with the first, upon which the picture has been formed. A board is put beneath them and a sheet of glass above, and the whole is pressed into close contact by screws. Being then placed in sunshine or daylight for a short time, an image or copy is formed upon the second sheet of paper. This image or copy is often invisible at first, but the image may be made to appear in the same way that has been already stated. But I do not recommend that the copy should be taken on calotype paper; on the contrary, I would advise that it should be taken on common photographic paper. This paper is made by washing good writing-paper first with a weak solution of common salt, and next with a solution of nitrate of silver. Since it is well known, having been freely communicated to the public by myself in the year 1839, and that it forms no part of the present invention, I need not describe it here more particularly, although it takes a much longer time to obtain a copy upon this paper than upon calotype paper, yet the tints of the copy are generally more harmonious and agreeable. On whatever paper the copy is taken it should be fixed in the way already described. After a calotype picture has furnished a good many copies, it sometimes grows faint, and the subsequent copies are inferior. This may be prevented by means of a process which revives the strength of the calotype pictures. In order to this it is only necessary to wash them by candle-light

with gallo-nitrate of silver, and then warm them. This causes all the shades of the picture to darken considerably, while the white parts are unaffected. After this the picture is of course to be fixed a second time. The picture will then yield a second series of copies, and a great number of them may frequently be made.

"Note. In the same way in which I have just explained that a faded calotoype picture may be revived and restored, it is possible to strengthen and revive photographs which have been made on other descriptions of sensitive photographic paper; but these are inferior in beauty, and moreover the result is less to be depended on: I therefore do not recommend them

"The next part of my invention consists in a mode of obtaining positive photographic pictures, that is to say, photo-graphics, in which the lights of the object are represented by lights, and the shades by shades I have already described how this may be done by a double process; but I shall now describe the means of doing it by a single process: I take a sheet of sensitive calotype paper and expose it to daylight, until I perceive a slight but visible discolouration or browning of its surface—this generally occurs in a few seconds. I then dip the paper into a solution of iodide of potassium of the same strength as before, viz. 500 grains to one pint of water. This immersion apparently removes the visible impression caused by the light—nevertheless, it does not really remove it; for, if the paper were to be now washed with gallo-nitrate of silver, it would speedily blacken all over. The paper, when taken out of the iodide of potassium, is dipped in water, and then lightly dried with blotting-paper. It is then placed in the focus of a camera obscura, which is pointed at an object. After five or ten minutes the paper is withdrawn and washed with gallo-nitrate of silver, and warmed as before directed. An image will then appear of a positive kind—namely, representing the lights of the objects by lights, and the shades by shades. Engravings may be very well copied in the same way, and positive copies of them obtained at once (reversed, however, from right to left). For this purpose a sheet of calotype paper is taken and held in daylight to darken it, as before mentioned; but for the present purpose it should be more darkened than if it were intended to be used in the camera obscura. The rest of the process is the same The engraving and the sensitive paper should be pressed into close contact by screws or otherwise, and placed in the sunshine, which generally effects the copy in a minute or two. This copy, if it is not sufficiently distinct, must be rendered visible, or strengthened, with the gallo-nitrate of silver, as before described. I am aware that the use of iodide of potassium for obtaining positive photographs has been recommended by others and I do not claim it here by itself as a new invention, but only when used in conjunction with the gallo-nitrate of silver; or, when the pictures obtained are rended visible or strengthened subsequently to their first formation. In order to take portraits from the life, I prefer to use, for the object-glass of the camera, a lens whose focal length is only three or four times greater than the diameter of the aperture. The person whose portrait is to be taken should be so placed that the head may be as steady as possible, and the camera being then pointed at it, an image is received on the sensitive calotype paper. I prefer to conduct the process in the open air, under a serene sky, but without sunshine: the image is generally obtained in half a minute, or a minute. If sunshine is employed, a sheet of blue glass should be used as a screen to defend the eyes from too much glare, because this glass does not materially weaken the power of the chemical rays to affect the paper. The portrait thus obtained on the calotype paper is a negative one; and from this a positive copy may be obtained in the way already described.

"Care must be taken to obtain paper of a very fine and even texture, and perfectly free from all foreign matter in its substance, which would cause ble-

mishes in the picture. The best kind of paper is that called blue wove post and each sheet, preparatory to its being used, should be carefully examined before a strong light, and those sheets rejected in which any spots or uneven texture is observed.

"This calotype paper is so exceedingly sensitive to the influence of light, that very beautiful copies of lace, feathers, leaves, pictures. or ancient writing may be made by the light of a common gas-light, or an argand oil lamp. Merely press the article to be copied against a piece of the prepared paper, with a sheet of strong glass, and expose them to the light, about four or five inches from the flame, for the space of two or three minutes."

Calotype paper, ready prepared, may be procured of Messrs. Hanneman and Malone, Regent-street, who are Mr. Fox Talbot's sole agents. These gentlemen have also some of the best specimens of the art ever produced, and are still advancing.

Sir D. Brewster's improved method of taking calotypes or talbotypes.

In the method now in use, the face of the negative Talbotye is placed directly upon the side of the paper which has been brushed over with a solution of nitrate, or ammonio-nitrate, of silver, and which is to receive the positive picture. In strong sunlight the picture is thus taken very quickly; but there is a roughness in the shades, owing to the formation of black specks, which destroys the softness of the picture, and in portraits gives a disagreeable harshness to the human face. In order to remove this defect, the auther first interposed thin plates of glass, with their surfaces sometimes ground and sometimes polished; but, though the divergency or diffusion of the light, passing through the *negative* picture, produced great softness in the *positive*, yet the outlines were too indistinct, though the Talbotypes looked very well when placed at a distance. He then tried the effect of interposing a sheet of writing-paper, without the water-mark, and of uniform texture. The result of this experiment fully answered his expectations. The diffusion of the light thus occasioned shaded off, as it were, all the sharp lines and points, and gave a high degree of softness to the picture. The effect was even improved by interposing *two* sheets of clean paper; and, with a very bright meridian sun he found that *three* sheets may be used with advantage. A similar effect may be obtained, in a smaller degree, by placing the *back* of the negative upon the positive paper, so as to cause the light to traverse the thickness of the negative; and this may be combined with one or more sheets of clean paper. This, of course, will be appropriate only with portraits; and it has the advantage (sometimes required) of making the figure look another way. To those who see the experiments above described for the first time, the effect is almost magical; as when the negative is removed, we see only a blank sheet of white paper; and our surprise is very great when, upon lifting this sheet, we discover beneath it a perfect picture, which seems, as it were, to have passed through the opaque and impervious screen.

IODISED PAPER.

The expense of metallic plates, and their inconvenience, particularly to travellers, renders it very desirable that some material, such as paper, might be employed instead of them. Some very tolerable effects may be produced upon silvered paper; but the pictures thus formed want the fine black surface, which is to contrast with the mercurial vapour, and which forms the chief charm of a good daguerréotype. Mr. Hunt first pointed out the mode of preparing this paper. He says:—

"Any of the ordinary photographic papers will darken by exposure to brown or dark olive colour. Exposed to the vapour of iodine, the paper becomes of a steel blue or violet colour. If subjected to solar influence in this state, mercurial vapour attacks all the parts on which the light

has acted, in the same manner as it does the iodised metallic plate, giving a tolerable picture. I also found that perfectly pure oxide of silver, spread on paper and iodised, was similarly disposed to receive the mercurial vapour, after it had been submitted to the sun's rays. The yellow-brown phosphate of silver was also found to acquire additional sensitiveness under the influence of iodine, and to yield a tolerable picture when exposed to the mercurial fumes.

"Papers which were prepared, by first saturating them with strong solutions of the nitrate of silver, and then exposed to phosphuretted hydrogen gas, until there was a complete revival of the silver over the surface of the paper, were found to be acted upon by iodine, in a similar way to the silver plates themselves, and for most purposes are capable of being substituted for them. The pictures, when the papers are well prepared, are formed as readily as upon the iodised plates, and are not wanting in the beauty of their general effect, or in the delicacy of their minute detail. It unfortunately happens that a considerable degree of risk attends the preparation of the paper by this spontaneous inflammable gas.

"Papers prepared in a similar way, substituting the sulphuretted for the phosphuretted hydrogen, are in nearly all respects equal to them. Some difficulties attend the preparation, but, by observing the following directions, paper of a very uniform dark grey surface may be prepared. The paper is first soaked in a solution of the muriate of ammonia, carefully wiped with cotton cloths, and then dried. It is next dipped in a solution of nitrate of silver, dried in the dark, and then carried into a vessel in which sulphuretted hydrogen is slowly forming. When it has darkened to an iron brown, the paper must be passed through water slightly impregnated with chlorine or muriatic acid, and again dried. It is once more dipped into an argentine solution, and, when dry, subjected a second time to sulphuration. These papers are best iodised by drawing them slowly over a saturated solution of any hydriodic salt, in which is dissolved a considerable quantity of iodine; care must be taken that one side only of the paper is wetted. It is then dried near the fire, and subjected in the camera to the solar agency. After mercurialisation, the picture is fixed most effectually by a strong solution of common salt used moderately warm.

"If, when these drawings are finished, they are placed in a solution of corrosive sublimate, the images entirely disappear, but after a few minutes they are seen, as if by magic, unfolding themselves, and gradually becoming far more beautiful than before—delicate lines, at first invisible or barely seen, are now distinctly marked, and a rare and singular perfection of detail is given to the photograph. The picture is thus restored by the agent which caused it to disappear, and it would appear that the mercury on the paper is slowly converted into a protochloride; but the *modus operandi* is not, however, quite evident."

Mr. Talbot originated a process for obtaining photographs upon polished copper plates. The tablet is exposed to iodine vapours, or otherwise immersed in a solution of iodine or bromine; after receiving the image in the camera, it is exposed to sulphuretted hydrogen. The picture exhibits peculiarity of shade and variety of colour, but is rather curious than useful. The photographs may be obtained upon plates of copper, silvered with an amalgam of chloride of silver, salt, and cream of tartar; or again, though less advantageously, upon paper coated with silver. It may here be again stated, that Mr. Talbot discovered the art of rendering a silver plate sensitive to the action of light, by means of the vapour of iodine, so early as 1838, the year previous to the announcement of the discovery of Daguerre.

PHOTOGRAPHY ON GLASS.

In consequence of the perfect transparency and evenness of glass plates, which render them particularly adapted for photographic purposes, many processes have been lately devised for rendering them available by spreading films of various substances, such as albumen, gelatine, serum, starch, collodion, &c., which are then rendered sensitive to light by being impregnated with iodine and various salts of silver.

MR. ARCHER'S PROCESS FOR TAKING COLLODION PICTURES.

"The Prepared Collodion (a solution of gun-cotton in ether) contains a small quantity of iodide of silver, previously dissolved in iodide of potassium, and should be sufficiently limpid to run freely over a plate of glass when poured upon it.* If the collodion be too thick, great difficulty will be experienced in obtaining an even coating; but, where of a proper consistency, plates of any size may be coated. Ether being the solvent in the collodion, by adding additional quantities any degree of thinness may be obtained.

"The plan of coating the plates is as follows:—Take a piece of flat glass cut to the size of your frame, and, having washed it with water, and wiped it quite dry, hold it at one corner, or, if large, place it on a levelling stand, and pour on the centre of it a good body of the collodion, prepared as described, which will readily diffuse itself equally over the surface. Immediately pour the liquid off again into a bottle from one corner, and by bringing the hand holding the plate down a little, that the liquid may run to the lower edge, and drawing the mouth of the bottle along, those lines first formed will run one into the other, and give a flat, even surface. Very little practice will soon enable any operator to obtain this result. The plate is now immediately, and before the whole of the ether has had time to evaporate, to be immersed in a bath of nitrate of silver, 30 grains to the ounce of distilled water, until the greasy appearance which it first presents on immersion is entirely gone, and the silver solution runs very freely over the surface. The plate should now, in its moist state, be placed in the camera, and the picture taken—the time of exposure varying of course with the light; but for a portrait, and with a moderately quick lens, from three to thirty seconds will be sufficient. The agent for developing these pictures is the pyro-gallic acid, as recommended by Mr. Archer. The solution of pyro-gallic acid should be made as follows:—Pyro-gallic acid, 3 grains; glacial acetic acid, 1 drachm; distilled water, 1 ounce. After exposing the plate in the camera, it is to be placed face upwards on a levelling stand, and a sufficient quantity of the above solution should be poured equally and quickly over the surface, and the picture allowed to develope, occasionally slightly moving the plate to prevent any deposit from settling at one spot. A few drops of a solution of nitrate of silver, five grains to the ounce, may also in dull weather be added to the pyro-gallic with advantage just before pouring it over the plate; but in very bright weather the picture will develope sufficiently quick with the pyro-gallic solution alone. The progress of developing may be readily judged of by holding a piece of white paper occasionally under the plate, and as soon as sufficient intensity has been obtained, the solution must be poured off, and the plate washed by a gentle stream of water. After this, the surface should be covered with a saturated solution of hypo-sulphite of soda, which will almost immediately remove the undecomposed iodide, and fix the picture; and another stream

* This solution may be purchased ready for use of Mr. Archer, 105, Great Russell Street, Bloomsbury.

of water must then again be poured over to free the plate from hypo-sulphite, and the picture is finished.

"In this state they are more or less negative by transmitted light: but the most beautiful and decided positives may be obtained by the simple addition to the pyro-gallic solution of a small quantity of nitric acid, care being taken not to add too much. I have also obtained purple and green pictures, the former by using acetate of lead, and the latter with acetate of lime and ordinary gallic acid.

"The pictures thus obtained may be treated as negative pictures, and printed from by any of the methods employed to obtain positives from paper negatives."

The glass plates employed should be of thin plate glass, cut to the size of the camera frame, and slightly ground on their edges The bath to contain the solution of nitrate of silver may be formed either of glass, porcelain, or gutta percha, care being taken that the solution of silver is kept perfectly free from dust. It will serve for a great number of pictures, and will only require to be renewed, should it, by accident, get the smallest quantity of hyposulphite of soda in it, or else fail to produce an even film of iodide, when the plate is immersed.

Various modifications of the foregoing process have been recommended for increasing its sensitiveness, such as the addition of arsenious acid, &c, and developing the picture with the protosalts of iron; but, although excellent pictures can be obtained by these processes, they do not appear to possess any advantage over Mr. Archer's process, which will give most beautiful results under favourable circumstances in less than one second, and with all the depth of tone that can be desired.

Very beautiful positive pictures are produced, if the solution of pyro-gallic and acetic acids, of the strength before indicated, be diluted with an equal bulk of distilled water, and a small quantity of strong nitric acid added, equal to the proportion of about three drops to two drachms of the diluted pyro-gallic acid. When the picture is set with the hyposulphite, washed, and dried, it can be protected from injury, and its effect greatly improved, by pouring over its surface some mastic varnish, diluted with camphine: a coating of black japan varnish over this will give a body to the picture at any time.

There are several methods of preparing the collodion, but the following will be found best:—Half an ounce of dried nitrate of potass in fine powder is to be mixed with three-fourths of an ounce of ordinary strong sulphuric acid of sp. gravity, about 1·850, in a porcelain capsule, with a glass rod, and half a drachm of clean dry cotton is then added as quickly as possible, and stirred about in the mixture for about five minutes; when removed, it is to be carefully and thoroughly washed with water, and dried by exposure to a warm atmosphere. Ten grains of the gun cotton thus obtained is dissolved in half an ounce of sulphuric ether, to which is added one drachm of alcohol. Five grains of iodide of potassium is now dissolved in the smallest quantity of water, and added to the collodion, together with sufficient sulphuric ether to enable it freely to flow over a glass plate.

The collodion should not contain too much iodide of silver, as it is liable to cause black spots to appear. For a developing solution, the proto-sulphate of iron will be found very excellent: five grains to one ounce of distilled water is the strength used.

Mr. Archer strongly recommends his process of whitening and blackening the collodion pictures, which may possibly prove interesting.

The picture being thoroughly washed in plenty of water, after fixing with hyposulphate of soda, is treated in the following manner.—Prepare a saturated solution of bichloride of mercury in muriatic acid. Add one

part of this solution to six of water; pour a small quantity of it over the picture at one corner, and allow it to run evenly over the glass. It will be found immediately to deepen the tones of the picture considerably, and the positive image will almost entirely disappear; but presently a peculiar whitening will come on, and in a short time a beautifully delicate white picture will be brought out. The negative character of the drawing will be almost entirely destroyed, the white positive image alone remaining. This picture, after being well washed and dried, can be varnished and preserved as a positive; but, nevertheless, even after this bleaching, it can be changed into a deep-toned negative, many shades darker than it was originally, by immersing it, after a thorough washing, in a weak solution of hyposulphate of soda. In a short time the white picture will entirely disappear, and a black negative image will be the result. It is very singular that the picture can be alternately changed from white positive to black negative many times in succession, and very often with improvement to the picture. By the above process a most perfect white or a deep black negative picture can be obtained, quite distinct from each other. The first point which I wish to enjoin in the manipulation is, the great cleanliness absolutely necessary. If this be neglected, no good result can ever be obtained. In cleaning the glass to prepare it for the collodion film, a dry cloth, to give the last polish, will be found all that is required; only taking care to avoid using a cloth the least soiled with hyposulphate of soda, for this forms with silver a peculiarly sweet gummy combination, very difficult to get rid of when once either on the cloth or on the glass. The furrowed appearance which the film of collodion will have when dried on the glass can be entirely avoided by moving the glass vertically backwards and forwards over the neck of the bottle, at the same time resting the corner of the glass on the bottle.

The nitrate of silver solution should be kept clear by filtration. There is no necessity to add iodide of silver to this solution, when used of the strength of 30 grs. Nit. Sil. to 1 oz. of water. The film after being poured on the glass should be allowed to dry for a few seconds in the air before being placed in the silver bath, and should be kept in it for at least a minute, otherwise the drawing will be streaky after the developement. The energy of the pyro-gallic solution can be increased by the addition of a small quantity of a saturated solution of protosulphate of iron, about 3 drops to 1 oz. of pyro-gallic solution.

A weak solution of iodide of potassium will be found to fix the picture and remove the iodide of silver from the film; also a saturated solution of chloride of sodium will fix the picture as far as the action of light is concerned.

Mr. Fox Talbot's mode of preparing Albuminized Glass Plates.

1. Take the most liquid portion of the white of an egg, rejecting the rest. Mix it with an equal quantity of water. Spread it very evenly upon a plate of glass, and dry it at the fire: a strong heat may be used without injuring the plate. The film of dried albumen ought to be uniform and nearly invisible. The glass plate is to be cleaned with great care, by the employment of a small quantity of caustic alkali and abundance of water, drying it perfectly, first with a piece of linen cloth, and subsequently with a portion of old silk. The plate is supported on the tips of the fingers of the left hand, and the clear albumen poured over in a considerable quantity, till the whole of its surface is wetted; the superfluous albumen is now poured off at one of the corners.

2. To an aqueous solution of nitrate of silver add a considerable quantity of alcohol, so that an ounce of the mixture may contain three grains of the nitrate. I have tried various proportions, from one to six grains, but

perhaps three grains answer best. More experiments are here required, since the results are much influenced by this part of the process.

3. Dip the plate into this solution, and then let it dry spontaneously. Faint prismatic colours will then be seen upon the plate. It is important to remark, that the nitrate of silver appears to form a true chemical combination with the albumen, rendering it much harder, and insoluble in liquids which dissolved it previously.

4. Wash with distilled water to remove any superfluous portions of the nitrate of silver. Then give the plate a second coating of albumen similar to the first; but in drying it avoid heating it too much, which would cause a commencement of decomposition of the silver. I have endeavoured to dispense with this operation No. 4, as it is not so easy to give a perfectly uniform coating of albumen as in No. 1. But the inferiority of the results obtained without it induces me for the present to consider it as necessary.

5. To an aqueous solution of prot-iodide of iron (140 grains to the ounce) add first an equal volume of acetic acid, and then ten volumes of alcohol. Allow the mixture to repose two or three days. At the end of that time it will have changed colour, and the odour of acetic acid as well as that of alcohol will have disappeared, and the liquid will have acquired a peculiar out agreeable vinous odour. It is in this state that I prefer to employ it.

6. Into the iodide thus prepared and modified the plate is dipped for a few seconds. All these operations may be performed by moderate daylight, avoiding however the direct solar rays.

7. A solution is made of nitrate of silver, containing about 70 grains to one ounce of water. To three parts of this add two of ac tic acid. Then if the prepared plate is rapidly dipped once or twice into this solution it acquires a very great degree of sensibility, and it ought then to be placed in the camera without much delay.

8. The plate is withdrawn from the camera, and in order to bring out the image it is dipped into a solution of protosulphate of iron, containing one part of the saturated solution diluted with two or three parts of water. The image appears very rapidly.

9. Having washed the plate with water it is now placed in a solution of hyposulphite of soda; which in about a minute causes the image to brighten up exceedingly, by removing a kind of veil which previously covered it.

10. The plate is then washed with distilled water, and the process is terminated. In order, however, to guard against future accidents, it is well to give the picture another coating of albumen or of varnish.

The following photographic process by Mr. C. J. Muller, from Patna in the East Indies, has been submitted to an experienced photographer; and he informs us that it offers many advantages over other processes, is easy in all its manipulatory details, and certain in its results.

"A solution of hydriodate of iron is made in the proportion of eight or ten grains of iodide of iron to one ounce of water. This solution I prepare in the ordinary way with iodine, iron-turnings, and water. The ordinary paper employed in photography is dressed on one side with a solution of nitrate of lead (15 grains of the salt to an ounce of water). When dry, this paper is iodized either by immersing it completely in the solution of the hydriodate of iron, or by floating the leaded surface on the solution. It is removed after the lapse of a minute or two, and lightly dried with blotting paper. The paper now contains iodide of lead, and protonitrate of iron. While still moist, it is rendered sensitive by a solution of nitrate of silver (100 grains to the ounce) and placed in the camera. After an exposure of the duration generally required for Talbot's paper, it may be removed to a dark room. If the image is not already out, it will be found

speedily to appear in great strength and with beautiful sharpness without any further application. The yellow tinge of the lights may be removed by a little hyposulphite of soda, though simple washing in water seems to be sufficient to fix the picture. The nitrate of lead may be omitted; and plain paper only, treated with the solution of the hydriodate of iron, and acetic acid may be used with the nitrate of silver, which renders it more sensitive. The lead, however, imparts a peculiar colorific effect. The red tinge brought about by the lead may be changed to a black one by the use of a dilute solution of sulphate of iron:—by which, indeed, the latent image may be very quickly developed. The papers, however, will not keep after being iodized."

Mr. Muller suggests that as iodide of lead is completely soluble in nitrate of silver, it might furnish a valuable photographic fluid, which could be applied at any moment when required. It appears perfectly applicable to the albuminized glass and collodion processes.

Mr. Hunt has described a process for taking photographs on waxed paper, which is employed in the following manner:—"A sheet of good writing paper is placed upon a hot iron plate, and rubbed over with wax until thoroughly saturated, taking care that the wax is uniformly diffused. If there should be an accumulation in any part, the paper is to be held up by one corner, in front of a fire sufficiently hot to liquify it, and allow it to flow off from the opposite corner. A great many sheets of this paper can be prepared at a time, and kept until required. To give these the sensitive coating, a large dish must be procured, and filled with a solution of iodide of potassium, made by dissolving about 500 grains of the iodide in a pint of water; if the paper is simply dipped in and then removed, it will be found to remain quite dry, owing to the repulsive action exerted between the water and the wax. Sheets of waxed paper are to be passed into the solution one after another, taking care to remove any air bubbles which may form on the surface of each, until as many as may be required are inserted, and the whole allowed to remain two or three hours. In that time a considerable quantity of iodide of potassium has been absorbed, and, on removing the papers and drying them, it will be found, on the application of a solution of nitrate of silver (about 17 grs. to the ounce) that a beautiful surface of iodide is produced, and can be rendered sensitive when required by the ordinary calotype process, with "gallo-nitrate of silver," and the picture developed either with the gallo-nitrate of silver or solution of protosulphate of iron. The resulting pictures are beautifully transparent, not in any respect inferior for copying from than those negatives which are waxed after the picture has been obtained, and all the details are very charmingly preserved."

Mr. Fry supposes that by dissolving a small quantity of gutta percha in the collodion, it gives improved pictures. His process is as follows: "Take a thin solution of Archer's Collodion Mixture, to which add one-third of a solution of gutta percha. To make the solution of gutta percha, put some small pieces of this substance into sulphuric ether, and at the expiration of a week sufficient will be dissolved. When the liquid is perfectly fine, it is poured over the glass, and, when set, the glass is placed in a bath of nitrate of silver, 30 grains to 1 oz. of water, where it should remain one minute. On taking the glass out of the bath, in order to obtain a negative picture, it is to be placed at once in the camera; but for a positive, it should be blotted with the finest bibulous paper. Immediately the moisture has been absorbed the film becomes firm, and may be placed at once in superposition to a glass or a waxed negative. The picture having been taken (which in strong gas light can be done in one second), pour some water over the surface, to allow the developing solution to flow freely over it.

The image can be brought out with great beauty by using the following solution:—

1 drachm of saturated solution of proto-sulphate of iron.
1 drachm of distilled water.
10 drops of nitrate of silver (30 grains of nitrate of silver to 1 oz. of water)
10 drops of acetic acid.

Should the picture prove tardy in its developement, throw off the sulphate solution, and after slightly washing the plate, pour over the surface a saturated solution of bichloride of mercury, four times diluted with water. Immediately it has flowed over the glass, wash and fix the picture by immersing it for some time in a bath of saturated solution of hyposulphate of soda.

The principal advantages derived from the use of gutta percha in negatives, is the increased tenacity which it gives to the film, by which a greater facility of manipulation is obtained, as with the addition the plate may be subjected to repeated washings, and lengthened immersion in the hyposulphite bath. Whether the gutta percha possesses in itself any photogenic property, must be left for further experiments to determine. I have no doubt that many other salts of silver will answer better than the iodide introduced into Mr. Scott Archer's collodion process; and also, that pyrogallic acid, protonitrate of iron, and other developing agents, may prove equally, if not more advantageous, for developing the image; but the recipe I have given will certainly enable parties to make beautiful negative as well as positive pictures.

Dr. Diamond has somewhat modified this process, and prefers the protonitrate of iron, as follows:—

The picture is taken as in the ordinary collodion process, and then developed by protonitrate of iron. This salt being thus prepared, 600 grains of the protosulphate of iron are dissolved in one ounce of water, and the same quantity of the nitrate of barytes in six ounces of water: these being mixed together protonitrate of iron and sulphate of barytes is formed by double decomposition. The negative image being developed, a mixture of pyrogallic acid and hyposulphite of soda, which has undergone partial decomposition, is poured over the plate, which is gently warmed. Upon this the darkened parts are rendered brilliantly white by the formation of metallic silver. This picture being backed up with black velvet assumes the air of a fine Daguerreotype without any of the disadvantages arising from the reflection of light from the polished silver surface.

Summary of Precautions.

Keep separate the cloths for cleaning the glass, &c.

Be careful to clean the glass thoroughly.

Any cloth when once used for cleaning a plate of glass after the application of the hyposulphite of soda should be kept for this purpose alone.

Avoid the too near proximity of diffused light, or that of a candle or lamp, unless it is shaded by a yellow screen of glass.

Take care that your solutions are put into bottles with lips.

Clean the stopper and neck of the collodion bottle after each day's use.

Avoid disturbing any sediment there may be at the bottom of the iodized collodion bottle; and if there should be much sediment, pour off the clear solution from it into a clean bottle for use.

Keep separate a cup or measure for the developing solution, as also one for the application of the hyposulphite of soda.

Keep clear all the solutions by filtration.

STERESCOPIC PICTURES.

In taking pictures for the stereoscope, when two cameras are employed, the distance between them should be about 1—10th of the distance from the part of the object that is focussed in the camera. The point of sight should be exactiy midway between the most distant and nearest object presented to the camera. For example:—In taking a group of portraits, the focus should be taken midway between the farthest and nearest sitter to the camera. When only one camera is used, then after taking one picture, it should be moved to the right or left 1—10th the focal distance, as above; in each case the distance from the object must be exactly equal from the camera in each of its positions. It will not answer the same purpose to move the figure or object round so as to present another phase, as then the lights and shades are all different in the two positions. Those who have the means of measuring an angle correctly, can take these pictures with more exactness by moving the camera through an arch of 10 degrees from its first position to its second, or when two are employed, placing them so that the included arch is equal to 10 degrees. Views must be taken with a small aperture, and only one and the same object must be focussed from each of the two positions, and the angle should be lessened as the distance between the nearest and farthest objects increase. Example: thus if the farthest object be twice as far from the camera as the near object, the angel should be 5 degrees to a central point between these two.

PHOTOGRAPHIC PICTURES ON ARTIFICIAL IVORY.

MM. Bouet and Mante have lately exhibited to the Paris Academy of Sciences specimens of photographic pictures taken on the material commonly called "artificial ivory," the manufacture of which is carried to great perfection in Paris. The process for taking these pictures is as follows:—The surface of the plate of artificial ivory is first cleaned with fine glass paper, which removes all trace of a greasy nature, and facilitates the absorption of the fluid. The plate is entirely immersed, for about one minute, in a solution of 20 grammes* of muriate of ammonia in 200 grammes of water. On its removal from the solution, the plate is suspended by one corner and allowed to drain completely; after which it is immersed in a bath composed of 40 grammes of nitrate of silver dissolved in 200 grammes of water. It is then allowed to drain as before, the whole operation being conducted in a darkened room. When thoroughly dry it may at once be used for the next operation, though it is better to polish it first by rubbing it with cotton moistened with spirits of wine and some Tripoli powder. When it has acquired by exposure in the camera, a somewhat deeper shade than is actually required, the plate is withdrawn and washed in water, after which it is immersed in either a hot or cold solution of 20 grammes of hyposulphite of soda in 100 grammes of water. When the proof has acquired the desired tint, the plate is washed in a large quantity of water to remove the whole of the remaining hyposulphite, and then hung up to dry. Before perfectly dry it is pressed between two thin pieces of white wood, to remove the remaining moisture, and enable it to keep smooth and flat when dry.

* The French *gramme* is equal to 15¼ grains English weight.

FINIS.

THOMAS SCOTT, PRINTER, WARWICK COURT, HOLBORN.